NAME: Ciba Geigy
I.D. NO.: RID001194323
FILE LOC.: R-9
OTHER:

Stabilization Investigation

Former CIBA-GEIGY Facility
Cranston, Rhode Island

Final Stabilization Design Documents
Operation and Maintenance Manual

Prepared For:
CIBA-GEIGY Corporation
444 Sawmill River Road
Ardsley, New York 10502

Prepared By:
Woodward-Clyde Consultants
201 Willowbrook Boulevard
Wayne, New Jersey 07470

Volume 3 of 4

June 1994
Project No. 87X4660D

REC'D 6-16-94
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Section | Page

Section 1

1.0
INTRODUCTION

CIBA-GEIGY Corporation (CIBA-GEIGY) has retained the services of Woodward-Clyde Consultants, Inc. to prepare this Operation and Maintenance (O&M) Manual for the groundwater capture, groundwater pretreatment, and soil vapor extraction (SVE) systems at the former CIBA-GEIGY facility in Cranston, Rhode Island. The O&M manual is organized into the following seven sections:

Section 1	-	Introduction
Section 2	-	Safety Policies and Procedures
Section 3	-	System Description
Section 4	-	System Operation and Potential Operating Problems
Section 5	-	Maintenance and Repair
Section 6	-	Sampling/Laboratory Testing
Section 7	-	Functional Specification

Only preliminary versions of the above sections have been prepared at this time, since none of the required equipment (with the exception of the existing sand filter and air stripper) has been purchased. As a result, specific operation and maintenance information is currently not available and complete operating and maintenance procedures can not be developed at this time. Also, CIBA-GEIGY plans to perform a process safety review on the Final Stabilization Design Documents (FSDD) prior to advertizement for bid. Recommendations developed during this review could also impact several sections of this document.

As equipment is purchased for all three stabilization systems, the O&M manual will be refined and further developed. During start-up of the systems, the O&M manual will be confirmed and revised accordingly. A final O&M manual will be issued following construction based on the actual as-built conditions.

Section 2

2.1 OVERVIEW

The policies and procedures presented herein are designed to:

- reduce the risk of employee injury and occupational illness;
- satisfy regulatory requirements regarding health and safety; and
- satisfy CIBA-GEIGY Corporation (CIBA-GEIGY) health and safety requirements.

All personnel involved with the groundwater capture, groundwater pretreatment, and soil vapor extraction systems (the "Facility") are required to comply with these policies and procedures. CIBA-GEIGY expects this commitment to the health and safety program from their employees and failure to comply may result in disciplinary action.

2.2 PROGRAM ORGANIZATION

For this project, the responsibilities of the WCC Project Manager and Site Safety Officer related to health and safety are as follows.

2.2.1 Project Manager

2.2.1.1 Responsibilities

- Assures that projects are performed in a manner consistent with current Ciba-Geigy Health and Safety Programs;

- Assures that project Health and Safety Plans are prepared, approved, and properly implemented;

- Implements Health and Safety Plans;

- Assures that adequate funds are allocated to fully implement project health and safety; and

- Coordinates with the Project Health and Safety Officer on health and safety matters.

2.2.2.2 Authority (Safety Related)

- Assigns a Health and Safety Officer-approved Site Safety Officer to the project and, if necessary, assigns a suitably qualified replacement;

- Suspends field activities if health and safety of personnel are endangered, pending an evaluation by the Project Health and Safety Officer and/or Corporate Health and Safety Manager; and

- Suspends an individual from field activities for infractions of the Health and Safety Plan, pending an evaluation by the Project Health and Safety Officer and/or the Corporate Health and Safety Manager.

2.2.2 Site Safety Officer

2.2.2.1 Responsibilities

- Directs health and safety activities on-site;

- Reports immediately all safety related incidents or accidents to the Project Health and Safety Officer and Ciba-Geigy Project Manager;

- Assists Ciba-Geigy Project Manager in all aspects of implementing Health and Safety Plans;

- Maintains health and safety equipment on-site; and

- Implements emergency procedures as required.

2.2.2.2 Authority

- Temporarily suspends field activities if health and safety of personnel are endangered, pending an evaluation by the Project Health and Safety Officer and/or Corporate Health and Safety Manager; and

- Temporarily suspends an individual from field activities for infractions of a Health and Safety Plan, pending an evaluation by the Project Health and Safety Officer and/or Corporate Health and Safety Manager.

The Ciba-Geigy Project Manager has overall responsibility for site safety; the Site Safety Officer has day-to-day responsibilities for monitoring and directing the program. The health and safety related responsibilities and authority of other members of the project team are described in the Health and Safety Manual.

2.2.3 Other Personnel

All CIBA-GEIGY and other field personnel must remain conscious of their safety responsibilities and comply with all the policies, procedures, and permits applicable to the ongoing work. Safety responsibilities of individual workers include the following:

- performing every job in a safe manner for the benefit of self, co-workers, contractors, and the protection of facilities;

- immediately reporting every injury, regardless of severity;

- reporting unsafe conditions and practices to a supervisor and correcting where possible;

- participating in safety meetings and training;

- assisting in reporting and investigating incidents, injuries, and serious potential incidents; and

- reviewing and becoming familiar with the contents of this and other pertinent safety manuals, handbooks, and publications.

2.3 GENERAL SAFETY RULES

The following general safety rules must be reviewed, implemented, and strictly adhered to, by all workers, as appropriate:

- Immediately report all injuries or incidents to a supervisor. Attend to the injured or ill employee.

- All fires or spills or leaks of hazardous materials must be reported immediately to a supervisor.

- All unsafe conditions must be reported to a supervisor. Unsafe equipment must be tagged with "DANGER - DO NOT OPERATE" tags.

- Whenever a safety device is disabled, removed from service, and/or defeated, a supervisor must be notified and the device tagged.

- All visitors must be authorized by the proper site representatives before entering or doing any work at the Facility.

- Do not operate equipment for which you are not qualified.

- Horseplay or fighting on premises is prohibited.

- Smoking is permitted in designated areas only. Eating or drinking is prohibited in the operating areas of the Facility.

- The use, possession, transportation or sale of illegal drugs, alcoholic beverages, fire arms, deadly weapons, or explosives on the premises is prohibited.

- Use handrails and step one step at a time when ascending or descending stairs. Running is not allowed in the Facility.

- When lifting loads manually, use proper lifting techniques such as bending knees, obtaining assistance, and mechanical lifting aids.

- Erect barricades around areas of hazardous work, such as holes in decking/flooring and work areas, trenches, or overhead activities, Only the person in charge may grant permission for entry into these areas.

- Work platforms, approved scaffolding, ladders, or safety harnesses must be used if the work height is greater than 6 feet from ground level. Any high elevation (greater than 6 foot) work must be done in a protected work platform with handrails, midrails, kick plates, and flooring or the worker must be protected from fall with a safety harness.

- All personnel, including visitors and contractors, are required to wear hard hats and safety glasses with side shields while in the Facility and not in a building providing overhead protection.

- General footwear consisting of substantial shoes or boots with ANSI approved steel toes must be worn in the Facility. More protective footwear may be required in particular areas or for specific jobs.

- Hearing protection is required when the noise level exceeds 85 dBA.

- If clothing becomes contaminated, the clothing must be removed as soon as possible.

- Personal protective equipment will be assigned and worn by personnel performing work requiring such equipment. Personal protective equipment will be consistent with the Material Safety Data Sheets when handling hazardous materials.

- Use only proper tools and equipment maintained in good working condition.

- Fire extinguishers, alarm boxes, fire doors, eyewash stations, first aid kits, and all other emergency equipment must be in good condition, inspected regularly, and kept clear of obstructions.

- All block valves on pressure relief systems must be locked or sealed open.

- Operation of equipment having a "DANGER - DO NOT OPERATE" tag is prohibited.

- Under normal operations, all operating machinery and electrical switch gear must have all required safety guards, switches, and alarms in place and functional.

- When transferring flammable or combustible liquids into metal containers, the metal containers must be grounded.

- Any operation of equipment outside the limits (temperature, pressure, flow) described in the Operation and Maintenance Manual will only be performed with written authorization of the Ciba-Geigy Project Manager.

2.4 SAFETY STANDARDS

2.4.1 Hot Work Procedures

The following procedures apply to maintenance or other tasks that are capable of producing a source of ignition and which are not directly connected with or controlled by normal operational activities. In general, hot work procedures are applicable to tasks involving sources of ignition and where flammable gas or vapor may exist.

Potential sources of ignition include:

- Welding and cutting
- Open flames
- Hot tapping
- Portable heaters
- Internal combustion engines
- Portable electrical tools
- Grinding
- Drilling
- Chipping
- Soldering
- Sandblasting
- Thawing frozen pipes
- Freeing seized bearings

Due to the numerous operations involving flammable materials which may be performed, it is impossible to list every situation or area capable of producing flammable vapors. However, the follow areas should always be considered hazardous:

- Soil Vapor Extraction System;
- Pipeline manifolds and pumps;
- Tanks and diked area; and
- Laboratories and sample storage facilities.

The following general precautions should be followed, as appropriate, when performing hot work:

- Do not perform hot work unless absolutely necessary. Consideration should be given to relocation the work to a safe area whenever possible.

- Hot work shall be done under the supervision of persons who understand the fire and explosion potential. The hot work will be performed by personnel sufficiently skilled to carry out the associated operations.

- Contracts should be made only with contractors who acknowledge understanding of hot work procedures and agree to have their employees abide by them. It is the Ciba-Geigy Project Manager's responsibility to maintain liaison with the contractor on all matters relating to fire prevention.

- Always monitor the area with a combustible gas indicator before starting hot work and while work is in progress. Combustible gas indicators must be calibrated with a suitable calibration gas prior to use.

- Keep fire extinguishers and other appropriate fire fighting equipment close by. If applicable, designate a person as fire watcher to extinguish small fires. The job site should be observed for at least 30 minutes after completion of the work to be sure that no hot spots remain.

- All bystanders must be out of the area of exposure.

- Detailed planning is essential. The supervisor in charge should review the work to be done with maintenance personnel, describing pertinent safety and fire prevention measures to be taken.

Before allowing hot work to start, the supervisor in charge should verify that the following applicable conditions have been met:

- piping connections have been blinded off or a section of pipe removed;

- valves are tagged and locked out;

- switches are tagged and locked out at breaker panel;

- vessel or pipe are depressurized;

- fire extinguishers are available;

- fire watches have been designated;

- flammable gas test has been made and additional tests will be made while the work is in progress; and

- vessel or pipeline have been vented and/or steamed, and are free of flammable gas.

An example of a Hot Work Permit is provided at the end of this section in Figure 2-1.

2.4.2 Lockout/Tagout Procedures

2.4.2.1 Scope

These procedures are required when an unexpected release of energy such as electrical, hydraulic, pneumatic, or mechanical could potentially cause injury to personnel. These procedures establish lockout/tagout procedures to prevent the unexpected release of energy.

An initial evaluation must be performed to identify potential exposures that must be isolated before safely working on equipment and appropriate affected personnel notified.

These procedures do not apply to minor tool adjustments or servicing activities that are routine, repetitive, and integral to operations.

2.4.2.2 Electrical Lockout/Tagout Procedures

Electrical lockout/tagout procedures must be used before commencing any work requiring personnel to work on or near de-energized circuit parts or equipment in any situation where there is danger of injury due to unexpected energization or startup of equipment.

- The person doing the work shall LOCK open the circuit breaker(s) or approved disconnect device.

- TAG the lockout with a dated and signed "DANGER-DO NOT OPERATE" tag. The reason for the lockout should be written on the tag.

- Other personnel working on this equipment will attach their lock and tag.

- Each lock will have only one key or a set of locks will have one key. The key will be held by the locking party until the job is completed.

- If a circuit cannot be locked out it must be de-energized and tagged. If the circuit requires disconnection or removal to ensure isolation, a qualified electrician must perform the work.

- The equipment will be tested at the on/off switch before beginning work after the locks are in place. This helps ensure that the right circuit has been locked out.

- Only the person(s) originally attaching the lock and tag is authorized to remove the lock and tag unless the person(s) is not available to remove the lock and tag. UNDER THESE CONDITIONS THE SUPERVISOR, AFTER CHECKING THE EQUIPMENT AND ASSUMING FULL RESPONSIBILITY, CAN REMOVE THE LOCK AND TAG AND PLACE THE EQUIPMENT IN SERVICE. The supervisor is responsible for notifying personnel that their lock(s) and tag(s) have been removed.

- Personnel unlocking equipment for energization are responsible to check with the work area to assure there is no hazard to personnel by starting/testing/re-energizing the equipment.

2.4.2.3 Process, Pneumatic, and Hydraulic Lockout/Tagout Procedures

Process, pneumatic, and hydraulic lockout/tagout procedures must be used before commencing any work requiring personnel to work on or near any energy sources such as process, hydraulic, or pneumatic fluids, or thermal or chemical systems where there is danger of injury due to the unexpected energization or startup of equipment.

The procedures for process, hydraulic and pneumatic lockout are essentially the same as the procedures for electrical lockout/tagout; the primary difference is in means of isolation.

Acceptable means of isolation in order of preference are as follows:

1. Blinding
2. Disconnection
3. Double block and bleed
4. Single block valve - valve must be locked closed
   - valve must not leak or have history of leaking
   - not acceptable for
     - high toxics
     - high pressure;
     - vessel entry; or
     - piping which will be open for extended periods of time.

2.4.2.4 Mechanical Energy Lockout/Tagout Procedures

- If springs are involved they must be released or physically restrained when necessary to immobilize mechanical equipment.

- The use of brakes is not an acceptable means of energy isolation. The use of blocks or chains in addition to the brake is required.

2.4.2.5 Review

At least annually, a documented review of all lockout/tagout procedures for the Facility must be conducted.

At a minimum, this review will include:

- identification of the equipment to which the procedure applies;
- the date of the review;
- a list of the employees reviewed; and
- the name of the supervisor conducting the review.

2.4.3 Confined Space Entry

This procedure establishes methods for preparation, entry, and restoration of a confined space to be entered by personnel. These procedures are designed to maintain a safe environment for personnel working in a confined space.

2.4.3.1 Scope

This procedure applies to excavations greater than 4 feet deep and to any confined space that is large enough to be entered bodily and has one or move of the following characteristics:

- limited or restricted openings for entry or exit;
- contains or has a potential to contain a hazardous atmosphere;
- is not intended for continuous occupation;
- has insufficient natural ventilation; or
- may contain known or potential hazards.

Confined spaces include, but are not limited to, storage tanks, frac tanks, tank trucks, process vessels, furnace boxes, sewer systems, ducts, flues, manholes, valve boxes, cellars, pipelines, pits, excavations, or other areas that may contain toxic, corrosive, flammable, oxygen deficient, or oxygen rich atmospheres.

Entry is defined as when any part of the entrants head breaks the plane of an opening into a confined space.

2.4.3.2 Pre-Entry Procedures

1. The space must first be isolated using the following techniques, as appropriate:

   - blinding of lines as near the space as possible;
   - disconnecting lines as near the space as possible; and
   - double block and bleed water and other non-hazardous lines.

A sketch of the space should be provided identifying the isolation and what technique was used to achieve isolation. <u>EVERY LINE MUST BE ISOLATED</u>.

2. Lockout all electrical sources to the space using the procedures outlined in the Electrical Lockout/Tagout Procedures.

3. The confined space must be cleared to remove vapors and contaminants from the space.

4. Establish and maintain ventilation to ensure movement of fresh air in the confined space.

5. The atmosphere in the confined space must be evaluated for the following:

   - Oxygen > 19.5 and < 23%
   - Flammable gases or vapors < 10% LEL
   - Toxic vapors - as necessary
   - Carbon monoxide < 5.0 ppm
   - Hydrogen sulfide < 1.0 ppm
   - Organic vapors < 25.0 ppm
   - Benzene < 1.0 ppm
   - Vinyl chloride < 1.0 ppm

   Calibrated instruments must be used to make these evaluations.

Verify with the Site Safety Officer which chemicals which should be measured in each particular confined space.

6. At least one properly trained and equipped "stand-by" person must be posted outside the confined space. This stand-by person's job is to maintain contact communication with workers in the confined space and to summon help should it be required. This person will not enter the confined space.

7. The need for a self-contained breathing apparatus (SCBA) or equivalent supplied air system shall be assessed by the Site Safety Officer. If determined to be necessary, it must be positioned, in complete working condition, outside the confined space.

8. Lifelines, harnesses, wristlets, or other appropriated retrieval equipment must be worn by entrants. A mechanical retrieving device must be available for vertical spaces more than 5 feet deep.

9. Equipment such as air movers and vacuum truck hoses shall be properly grounded or bonded to prevent static sparks. Any electrical equipment used in the confined space should either be 12 volt DC or be 120 VAC with ground fault interrupter (GFI).

10. Personal protective equipment such as coveralls, gloves, boots, safety glasses, and hard hat must be provided.

11. Personnel trained in first aid and CPR must be available at the site.

12. Appropriately sized fire extinguishers and other fire fighting equipment, if necessary, must be available.

13. A communication system must be established between the stand-by person and the entrants.

14. Signs and/or barricades must be posted outside the confined space.

15. Entrants and standby persons must be trained and familiar with the following:

    - assigned duties;
    - any hazardous material which may be present;
    - reserve equipment;
    - procedures and emergency contacts;
    - communication systems; and
    - personal protective equipment.

16. Rescue services and the method of communicating with rescue services must be listed on the permit.

17. A pre-entry safety meeting must be held to discuss all the above items including the specific confined space to be entered.

2.4.3.3 Entry Procedures

1. Entry may be made after all the items in Section 2.4.3.2 are completed and the confined space entry permit has been signed and issued. An example of a Confined Space Entry Permit is provided in Figure 2-2.

2. The stand-by person will remain in the stand-by position unless adequately relieved. Unauthorized persons will not be allowed entry.

3. The atmosphere inside the confined space will be continuously monitored and recording periodically made on the permit. If hot work is required in the confined space, a separate "Hot Work Permit" must be issued.

2.5 ELECTRICAL SAFETY

The following electrical safety requirements must be reviewed, implemented, and strictly adhered to by all workers, as appropriate:

- Only qualified and trained personnel are allowed to repair or install electrical equipment.

- All conductors are considered to be energized.

- CPR/first aid trained people must always be present at the Facility when electrical work is being performed.

- All circuits must be de-energized before beginning work. Refer to Lockout/Tagout Procedures in Section 2.4.2 for details of how to execute the lockout/tagout.

- Use suitable personnel protective equipment including rubber gloves, mats, and blankets to provide insulation from other elements which are energized or grounded. Rings, watches, or other metallic objects must not be worn while working on electrical equipment.

- Blown fuses shall be replaced only with the proper type and rating.

- Use of metal ladders is prohibited while working on or near electrical equipment or conductors.

- Never use defective electrical equipment.

- The use of field electrical equipment outdoors requires a GFI outlet.

- All power lines will be considered energized unless proper measures have been taken for de-energizing overhead power lines. Any part of the crane, boom, or machinery shall not be permitted within 20 feet of power lines.

2.6 EMERGENCY PROCEDURES

2.6.1 General

Emergency procedures must be available for emergency situations that could occur. Examples of situations requiring emergency procedures are fire, explosion, injury, spills of hazardous materials, toxic or combustible gas releases, or moving equipment accidents.

The Ciba-Geigy Project Manager is responsible for ensuring emergency procedures are available for all emergency situations that may arise during operation of the Facility.

All specific emergency procedures must contain the following common elements:

- internal/external communication;
- accountability for all employees; and,
- rescue procedures

2.6.2 Training Requirements

Facility personnel must be thoroughly trained as follows:

- Waste water operators and supervisors must be trained to Level 3 proficiency as described in the OSHA 29 CFR 1910.120 Regulations;

- Drills of the emergency plan will be performed every six months. Each drill execution will be followed by a critique and a written report distributed to the Project Manager and the Project Health and Safety Officer;

- Preparation of chain-of-custody forms;

- Response to medical, fire, or other emergencies;

- Evacuation routes; and

- Location and use of emergency equipment.

2.6.3 Site Communications

A site communication system will be established to warn all Facility personnel if an emergency occurs. This system must communicate the essentials needed for those individuals to protect themselves in an emergency. In addition, the communication system must be able to effectively notify all the required outside entities should an emergency occur.

Specific emergency procedures for the following must be developed:

- fire/explosion;
- medical emergency;
- toxic/flammable release to atmosphere; and
- spills of hazardous material.

2.7 COMPRESSED GAS CYLINDERS

2.7.1 General Safety Procedures

- Do not move or store cylinders without the protective cap over the valve.

- Move cylinders with a cart or carrier for cylinders and get help as necessary.

- Cylinders moved by a crane or derrick must be secured in a basket. Use of slings, ropes, or electromagnets is prohibited.

- Cylinders should not be allowed to strike each other and should only be used to contain gas.

- Threads on a regulator or fitting must correspond to those on the cylinder valve outlet.

- Always use a pressure reducing regulator on a cylinder unless the total system being discharged to is capable of handling the cylinder pressure.

- Never use oil or grease as a lubricant on valves or attachments to oxygen cylinders.

2.7.2 Storage of Cylinders

- Properly secure cylinders with chains, brackets, or ropes to prevent falling.

- Do not store oxygen cylinders within 20 feet of combustible gas cylinders. Adjacent storage can be accomplished provided a 5 foot or higher wall separates the cylinders and the wall has a fire rating of 30 minutes.

- Store cylinders in a safe, dry, well ventilated area.

- Store empty and full cylinders separate and each identified as full or empty.

2.8 INDUSTRIAL HYGIENE PROCEDURES

The objectives of these procedures are as follows:

- protect the health of personnel and the public;

- identify chemical stresses, physical and biological agents, and ergonomic hazards which can lead to occupational illnesses; and

- implement controls that prevent or minimize potential personnel exposures and/or illness.

Potential hazards at the Facility must be identified and evaluated and the following concerns addressed:

- A comprehensive and historical inventory of all potential chemical, physical, and biological agents in the work place must be developed and updated regularly.
- Potential exposures must be identified by determining the chemicals that an individual may come in contact with and by job tasks and work practices.
- Potential exposures must be evaluated by performance of industrial hygiene surveys.
- Exposure levels must be communicated to all personnel.
- Recommendations for lowering exposures to acceptable levels will be addressed and action plans developed for implementation.

Individual monitoring and exposure records will be maintained by the Site Safety Officer and available to all employees.

All workers will be part of a medical surveillance program.

The respiratory protection program for this Facility will be in accordance with Ciba-Geigy's Standard Operating Procedures.

The personnel protective equipment program for this site will be in accordance with Ciba-Geigy's Standard Operating Procedure.

2.9 HAZARD COMMUNICATION POLICY

2.9.1 General Company Policy

Ciba-Geigy is committed to informing its employees of hazardous substances present in their places of work in accordance with the OSHA Hazard Communication (HAZCOM) requirements, OSHA Regulations 29 CFR 1920.1200 and 1926.59. This program applies to all work operations where Ciba-Geigy employees may be exposed to hazardous substances.

Under the HAZCOM program, Facility personnel will be informed of the contents of the HAZCOM Regulations, the hazardous properties of chemicals with which they work, and safe handling procedures and measures to take to protect themselves from these chemicals.

2.9.2 Material Safety Data Sheets and Chemical Hazard Information

Material Safety Data Sheets (MSDS) provide specific information on the chemicals to which Facility personnel may be exposed. The MSDS should be a fully completed OSHA Form 174 or equivalent. Every effort will be made to obtain all pertinent MSDS or similar chemical hazard information whenever chemical exposure of personnel is possible.

The Site Safety Officer is responsible for acquiring and updating MSDS for chemicals stored in the groundwater capture, groundwater pretreatment, and soil vapor extraction systems.

2.9.3 Labels and Other Forms of Warning

Hazardous chemicals used by Facility personnel will be properly labeled. Original labels will list the chemical identity, appropriate hazard warnings, and the name and address of the manufacturer. Referral will be made to the corresponding MSDS to assist in verifying label information. Original labels will not be defaced or removed.

If chemicals are transferred from a labeled container to a portable container that is intended only for immediate use, no labels are required on the portable container. However, no hazardous materials or chemicals should be permanently used or stored in unlabeled containers.

2.9.4 Training

All personnel who work with or who are potentially exposed to hazardous chemicals will receive initial training on the Hazard Communication Standard requirements and the safe use of those chemicals. Those individuals involved in working with hazardous waste have chemical hazard training included in their basic health and safety course, in the 8-hour refresher course, and in project specific briefings.

Facility personnel not involved in the hazardous waste practice who are potentially exposed to hazardous chemicals or contaminated samples will be trained in:

- The basic requirements of HAZCOM and employees' right to information on chemical hazards.
- WCC's program to comply with HAZCOM and procedures to follow to review the standard, the company program, and MSDS record keeping/availability.
- How to interpret and use the labels on containers of hazardous materials.
- The potential physical hazards and health effects of the hazardous substances and how to use MSDS for more information.
- Methods and observations that may be used to detect the presence or release of chemicals.
- The measures that employees can take to protect themselves from chemicals.

All HAZCOM training will be documented by a sign-in sheet recording each employee's attendance, the date, and the training topics covered. This sign-in sheet will be retained by the Health and Safety Officer. Such training can be performed by any of the following individuals:

- Ciba-Geigy Project Manager;
- Site Safety Officer;
- Project Health and Safety Officer; or
- Corporate Health and Safety Manager.

The implementation of the Hazard Communication Program will be under the general direction of a Certified Industrial Hygienist.

2.9.5 Protective Measures

The use of chemical splash goggles, gloves, protective clothing, boots, and possibly respiratory protection may be required during testing of potentially contaminated samples or the handling of hazardous chemicals. If respiratory protection is used, it must be in full compliance with OSHA Regulations 29 CFR 1910.134 and 29 CFR 1926.103. All personnel protective equipment used will be in accordance with Subpart I of OSHA Regulations 29 CFR 1910 and Subpart E of OSHA Regulations 29 CFR 1926. Any emergencies involving hazardous chemicals or potentially contaminated samples must be reported to the Ciba-Geigy Project Manager and the Project Health and Safety Officer.

2.10 INCIDENT/ACCIDENT INVESTIGATION PROCEDURE

The objectives of accident investigations are to determine the immediate and underlying causes of accidents and to recommend corrective actions to prevent similar incidents/accidents from occurring.

For purposes of this procedure, an accident/incident is defined as follows:

- illness resulting from chemical exposure;
- physical injury to Facility personnel;

- fire, explosion, or flash from the Facility;
- property damage to the Facility;
- infractions of safety rules;
- unexpected chemical releases or exposures; or
- complaints from neighbors concerning any part of the facility operation.

The above list is not intended to be all inclusive but gives examples of accidents/incidents which are covered by this procedure.

The Incident Form presented in Figure 2-3 will be used as the report format for incidents and accidents.

The incident/accident will be investigated by the Site Safety Officer and Ciba-Geigy Project Manager within 24 hours of occurrence.

At the discretion of the Project Manager and the Site Safety Officer, additional resources may be utilized to accomplish a successful accident investigation.

Recommendations to prevent the accident in the future must be included in the accident investigation report.

<u>REMEMBER:</u> ACCIDENT INVESTIGATIONS GO BEYOND ASSESSING BLAME. IT IS IMPORTANT TO DETERMINE THE ROOT CAUSES OF ACCIDENT/INCIDENTS.

FIGURE 2—1

HOT WORK PERMIT

WORK AREA	EQUIPMENT AFFECTED
WORK TO BE DONE	
SCHEDULED FINISH — DAY — DATE — TIME — AM PM	SCHEDULED FINISH — DAY — DATE — TIME — AM PM

EXPLAIN TYPE OF WORK

COMBUSTION HAZARD	SPARK PRODUCING HAZARDS	OTHER HAZARD
WELDING ______	CHIPPING ______	ELECTRICAL ______
BURNING ______	GRINDING ______	VEHICLE ENTRY ______
OPEN FLAME ______	DRILLING ______	OTHER ______

CHECK TYPE OF HAZARDS		CHECK SPECIAL PROCEDURES REQUIRED	
TOXIC ______	SPILLED ______	TIGHTEN JOINTS UNDER PRESSURE ___	RADIOACTIVE EQUIPMENT ___
CORROSIVE ______	HOT ______	VESSEL ENTRY ___	WELDING UNDER PRESSURE ___
FLAMMABLE ______	CHEMICAL CLEANING ______	UNGUARDED EQUIPMENT ___	WELDING ON STEEL ___
OTHER ______		OTHER ___	UNPLUGGED UNDERGROUND ___

PERSONAL SAFETY PREPARATION	EQUIPMENT SAFETY PREPARATION	
PROTECT AGAINST ______	ISOLATE EQUIPMENT	ELECTRICAL SAFETY
AIR MASK	STOP TRANSFERS	LOCK CIRCUITS
SCBA	TAG-OUT AND LOCK-OUT	EXPLOSION-PROOF EQUIPMENT
COVERALLS	DISCONNECT AND BLANK	NON-SPARK TOOLS
DUST RESPIRATOR	POST WORK SIGNS	SPARK CONTAINERS
SAFETY SHOWER	SET UP BARRICADE	WELDING AND SPARK PROTECTION
ACID SUIT	BLOCK ROADWAY	GROUNDING
FACE SHIELD	OTHER	OTHER
CHEMICAL GOGGLES		
RADIO ______		FIRE SAFETY
EVACUATION INSTRUCTIONS	CLEAN EQUIPMENT	AREA ALARM ______
TWO ESCAPE ROUTES	STEAM	LAID OUT
LIFELINE HARNESS	FILL AND DRAIN	BLEED STEAM HOSE
ACID-PROOF LIFELINE	REMOVE DEPOSITS	RUN WATER HOSE
RUBBER GLOVES	WATER WASH	FIRE WATCH
RUBBER BOOTS	INSPECT FOR LEAKS	KEEP AREA WET
RAIN CLOTHES	VISUALLY INSPECT	COVER SEWER OPENINGS
NOMEX SUITS	VENTILATE	FIRE EXTINGUISHER
EAR PROTECTION	OTHER	FIRE BLANKET
ACCESS ASSISTANCE		OTHER
OTHER		

GAS TEST: SPECIFY NUMBER OF HOURS BETWEEN TESTS. IF START ONLY, ENTER "S". IF CONTINUOUS, ENTER "C". TURN AUXILIARY AIR OFF TO CONDUCT TESTS.

LOCATION	EXPLOSIVE %	TYPE OF GAS H_2S, S, CO, O, OTHER	AUTHORIZED TESTER	TIME	REMARKS
AREA					
EQUIPMENT					

OPERATING PERSONNEL TO BE PRESENT	VALID FOR SHIFT PERIOD BEGINNING
AT START OF WORK	DAY
AS STAND BY	DATE
IN CASE OF TROUBLE	TIME — AM PM

EHS-003

FIGURE 2–2

CONFINED SPACE ENTRY PERMIT
(page 1 of 2)

Project Name/No.________________________

Location of Confined Space________________________

Purpose of Entry and Description of Work

____

____

Possible Hazards________________________

____

____

Names of Authorized Entrants:

____

____

____

Names of Eligible Attendants:

____

____

____

Individuals to be In Charge:

____

____

____

Rescue Service Information:

Responding Team: ________________________

Address: ________________________

Phone No.: ________________________

Hazard Control Measures (e.g. Ventilation)
Complied? __________ (SSO must initial prior to entry)

____

____

____

List of Rescue Equipment Required on Site
Complied? __________ (SSO must initial prior to entry)

____

____

____

Communication Procedures and Equipment
Complied? __________ (SSO must initial prior to entry)

____

____

____

Personal Protective Equipment Required
Complied? __________ (SSO must initial prior to entry)

____

____

____

Lockout/Tagout Procedures Required
Complied? __________ (SSO must initial prior to entry)

____

____

____

Comments/Additional Information

____

____

____

FIGURE 2-2 (CONT'D)

CONFINED SPACE ENTRY PERMIT
(page 2 of 2)

Test	Location	Reading	Acceptable Range
Oxygen	______	______%	19.5-22%
Flammability	______	______%LEL	Less than 10%
Toxics (Specify)			
______	______	______	______
______	______	______	______
______	______	______	______
______	______	______	______

Entry Date ______

Duration: Start Time ______ End Time ______

Is hot work to be performed? Yes ______ No ______

Individual in charge of entry approval:

______ ______ ______
Name Signature Date/Time

The individual responsible for entry verifies that all actions and conditions have been met for safe entry into the described space.

Permit Cancellation

All work is completed and all entrants are exited from the permit space.

______ ______
Signature of Individual in Charge Date/Time

FIGURE 2-3
HEALTH AND SAFETY INCIDENT REPORT

Project Number________________ Date/Time of Incident________________

Project Name________________ Project Location________________

DESCRIPTION OF INCIDENT (Describe what happened and possible cause, identify individuals involved, witnesses, and their affiliations, and describe emergency or corrective action taken.)

____
____
____
____
____
____
____
____
____
____
____
____
____
____
____
____
____
____

Reporter: ________________ ________________ ________________
Print Name Signature Date

Reporter must deliver this report to Ciba-Geigy Project Manager within one day of the date of the incident for medical treatment cases and within five days for all other incidents.

Reviewed by: ________________ ________________ ________________
Print Name Signature Date
Project Health and Safety Officer

Distribution:

_______ Corporate Health and Safety Manager, ________________
_______ CIBA-GEIGY Project Manager,________________
_______ Site Safety Officer,________________
_______ Personnel Manager (Medical Treatment Cases only),________________
_______ ________________

Section 3

3.0 SYSTEM DESCRIPTIONS

3.1 OVERVIEW

This chapter presents system process descriptions for:

- The groundwater capture system;
- The groundwater pretreatment system; and
- The soil vapor extraction (SVE) system.

The process descriptions for each of these systems are presented below.

3.2 PROCESS

3.2.1 Groundwater Capture System

The main design criterion for the groundwater capture system is to reverse (and maintain the reversal of) the hydraulic gradient at the bulkhead from its current direction (southeast/toward the Pawtuxet River) using the lowest practical pumping rates. In order to meet this main criterion, two secondary design criteria must be met:

- Drawdown ranging from 0.5 to 1.7 feet (depending on location) will be required on the landward side of the bulkhead; and
- Changes in the groundwater level at the bulkhead caused by infiltration of precipitation will not effect hydraulic gradient reversal.

3.2.1.1 Description

The groundwater capture system includes two to four recovery wells (PW-110, PW-120, PW-130, and PW-140), the locations of which are shown in Figure 3-1. A process and instrumentation (P&I) diagram for the groundwater capture system is presented in drawings I-1A and I-1B of Volume 4. The process flow diagram for the complete stabilization system is presented in drawings M-1A and M-1B of Volume 4.

A submersible pump will be installed in each recovery well; the discharge from each well will be conveyed to a common collection pipe which conveys the combined groundwater to the groundwater pretreatment system.

3.2.1.2 Performance Standards

The following performance standards are used for measuring compliance with the design criteria:

- Drawdown on the landward side of the bulkhead will be monitored by continuous measurements of groundwater levels in wells near the bulkhead. To ensure that the required drawdown is achieved at the bulkhead, two to four recovery wells will be installed along the bulkhead; and

- Changes in groundwater levels at the bulkhead caused by the infiltration of precipitation will be monitored by continuous measurements of groundwater levels near the bulkhead, however, changes in pumping rates may not occur.

3.2.1.3 Individual Units

The groundwater recovery system, consisting of two to four recovery wells, is constructed as follows:

- Wells are constructed of 6-inch diameter stainless steel screens and casings.

- Well casings are Type 304 stainless steel. The approximate length of casing for each well is as follows:

PW-110	-	6 feet of casing to grade (15 to 9 ft mean sea level (MSL))
PW-120	-	5 feet of casing to grade (13 to 8 ft MSL) and 17 feet of casing across the Silt unit (-2 to -19 ft MSL)

- Wells screens are Type 304 stainless steel (Johnson Filtration Systems Vee-Wire Brand) with variable slot sizes selected based on the results of the sieve tests. The approximate length of screen for each well is as follows:

PW-110	-	20 feet of screen (9 to -11 ft MSL)
PW-120	-	10 feet of screen (8 to -2 ft MSL) and 15 feet of screen (-19 to -34 ft) MSL

- Wells are completed using 5 foot long silt sumps.

- Gravel pack material (as provided by Jessie Morie Co.) selected using the results of the sieve analyses extends a minimum of 1 foot above and below each screened interval.

- Well heads are installed with an above-grade pre-engineered structure to contain all controls, flow meters and water level measurement instruments.

- Each well has a dedicated Grundfos Redi-Flo Environmental submersible pump. Pump sizes are as follows:

PW-110	-	60 gpm (Model 60S50)
PW-120	-	16 gpm (Model 16E9)

- Well pump controls are integrated into the programmable logic controller (PLC) located in the well house.

- Well monitoring instruments including the individual magnetic flow meters and level probes are linked to a PLC for data logging.

3.2.2 Groundwater Pretreatment System

The main design criterion for the pretreatment system is to provide pretreatment of the groundwater prior to discharge to the City of Cranston publicly-owned treatment works (POTW).

3.2.2.1 Process Description

The pretreatment system is divided into three components:

A) Liquid-phase treatment,
B) Vapor-phase treatment, and
C) Sludge handling.

The process flow diagram for the groundwater pretreatment system is presented in drawing M-1A of Volume 4. Drawings M-2 and M-3 show the layouts of major equipment on the first (main) floor and the second floor of the warehouse building respectively. The process and instrumentation diagrams (P&IDs) for the groundwater pretreatment system are presented in Drawing I-1 through I-9.

The following unit processes are used in the pretreatment system.

A) The liquid-phase treatment portion includes:

1) Equalization/flow measurement,
2) Oxidation/pH adjustment,
3) Flocculation/clarification,
4) Sand filtration,
5) Air stripping,
6) Aqueous-phase activated carbon adsorption,
7) Final pH adjustment,

8) Flow measurement and totalization, and
9) Effluent sampling.

B) The vapor-phase treatment portion of the system includes:

1) Dehumidification, and
2) Vapor-phase activated carbon adsorption.

C) The sludge handling portion of the system includes:

1) Sludge thickening, and
2) Sludge dewatering.

3.2.2.2 Performance Standards

The following performance standards are used for measuring compliance with the design criteria:

- For the liquid-phase portion of the pretreatment system, the performance standards to be used will be the anticipated effluent discharge limits established by the City of Cranston for the overall protection of the environment and to minimize any potential adverse impact on the POTW. The anticipated effluent concentration-based limits are presented in Table 3-1.

- For the vapor-phase portion of the pretreatment system, the performance standards used will be the maximum emission rates promulgated by the Rhode Island Department of Environmental Management (RIDEM) - Division of Air and Hazardous Material. These emission rates have been established by RIDEM to ensure the overall protection of the environment and minimize any potential impact on human health. The emission rates are presented in Table 3-2.

- For the sludge handling portion of the pretreatment system, the equipment utilized therein is selected and sized to facilitate thickening and dewatering of the solids precipitated in the treatment system to a dryness adequate for off-site landfill disposal.

3.2.2.3 Individual Unit Processes

The design criteria for each unit process employed in the groundwater pretreatment system are discussed in detail below.

A) Liquid-Phase Treatment

1) Equalization/Flow Measurement

Purpose: Equalization is provided to minimize drastic fluctuations in groundwater flow and constituents fed into the pretreatment system. The groundwater pretreatment system is equipped with two equalization tanks within a concrete diked area to provide secondary containment of the groundwater.

Equalization Tank No.1

Groundwater extracted by the groundwater capture system will be conveyed to Equalization Tank No. 1. Process water from selected unit operations within the pretreatment system (discussed in Chapter 2 of Volume 1) also will be conveyed to this equalization tank.

Equalization Tank No. 1 will be constructed of epoxy-coated carbon steel and will have a 50,000 gallon capacity. Equipment provided for the tank will include a mixer and level controls. The tank also will be covered for control of VOC emissions and the head space of the tank will be exhausted to the vapor-phase treatment system.

Equalization Tank No. 2

Groundwater extracted by the SVE system (located at SWMU-11) will be conveyed to Equalization Tank No. 2.

Equalization Tank No. 2 also will be constructed of epoxy coated carbon steel and will have a 12,000 gallon capacity. The tank will be equipped with a mixer and level controls. As with Equalization Tank No. 1, a cover will be provided for control of VOC emissions.

Flow Measurement and Recording

Groundwater from the two equalization tanks will be pumped and combined prior to the oxidation tank. The following instrumentation will be provided in line from the equalization tanks to the oxidation tank:

- Pressure gauges
- Flow element
- Flow indicator transmitter
- Flow totalizer/recorder
- Sample ports

2) Oxidation/pH Adjustment Tanks

Purpose: A two-stage system is provided to oxidize the dissolved ferrous iron in the groundwater to the less soluble ferric iron form. The first stage is used to oxidize the dissolve iron and adjust the pH of the groundwater (if required). The second stage allows entrained air to be released from the iron floc to enhance settling. Additional pH adjustment (if required) is provided prior to flocculation.

Oxidation Tank

The oxidation tank will be constructed of epoxy coated carbon steel and will have a 6,000 gallon capacity. A low-pressure, blower will be used to inject air into the groundwater for oxidation. The tank will be equipped with a mixer, chemical feed system, and pH controls. A cover will be provided for control of VOC emissions. Following oxidation, groundwater flows by gravity to the deaeration/pH adjustment tank.

A chemical oxidation system using a thirty-five (35) percent hydrogen peroxide (H_2O_2) solution as the oxidant will be available as a standby system. If deemed necessary (e.g.,elevated levels of manganese in the groundwater), H_2O_2 will be added (at a concentration of about 75 to 100 parts per million (ppm)) to the oxidation tank in lieu of air to facilitate complete conversion of the dissolved iron and manganese present in the groundwater to insoluble precipitates. The H_2O_2 will be stored in 300-gallon totes.

Deaeration/pH Adjustment Tank

A 6,000 gallon capacity epoxy coated carbon steel tank will be used for deaeration and pH adjustment. The tank will be equipped with a mixer, chemical feed system, and pH controls. The tank will be covered for control of VOC emissions. The pH will be controlled with twenty-five (25) percent sodium hydroxide (NaOH) solution added automatically by the pH controller. NaOH will be stored in 300 gallon totes. After deaeration and pH adjustment, groundwater flows by gravity to the flash mix zone of the inclined plate separator.

3) Flocculation/Clarification

Purpose: Flocculation/clarification of the groundwater is required for the agglomeration and removal of insoluble precipitates formed after oxidation and pH adjustment.

An inclined plate separator with integral flash-mix and flocculation zones is provided.

Flash Mixing/Flocculation Zones

As part of the inclined plate separator, a 60 gallon flash mixing zone will be provided top mix the polymer with the iron floc formed during air oxidation. Following flash mixing, a 4,000 gallon flocculation zone will be provided to allow the floc to coagulate and increase in size prior to settling. A low rpm mixer will be provided in the flocculation zone to prevent the iron floc from being disturbed in this region.

Lamella Gravity Settler

An inclined plate separator with a surface area of about 640 square feet will be provided to separate the iron floc from the groundwater. To provide the required surface area, several FRP plates installed at an 55 to 60° angle will be installed in the lamella gravity settler portion of the unit. A maximum hydraulic loading rate of 0.4 gpm per square-foot of plate area will be applied to allow the iron floc to separate and settle.

To enhance the flocculation formation, a recycle flow (about 5 percent of the total influent flow) is provided from the under-flow of the inclined plate separator to the flash mixing zone. This recycle flow increases the suspended solids concentration in the groundwater to a level sufficient for proper flocculation to occur. An air diaphragm pump (controlled by the PLC) is used for conveying the recycle flow. The remainder of the sludge flow is pumped to a sludge thickening holding tank.

Groundwater flows by gravity to the next (sand filtration) unit process.

4) Sand Filtration

Purpose: A continuous backwashing sand filter is provided in the pretreatment system to facilitate removal of the residual suspended solids and minimize clogging in the air stripping unit.

Sand Filter

A Dynasand DSF-38 continuous backwashing sand filter will be used for filtration. This is a epoxy coated carbon steel vessel with a filtration area of 38 ft^2. The filter bed is turned continuously by the air-lift pump in the center of the vessel. As the sand reaches the top of the air-lift pump, the residual suspended solids are trapped in the reject weir while the sand returns to the filter bed. The backwash (reject) is conveyed from the reject weir by gravity to Lift Station No. 3, from which it is pumped to Equalization Tank No. 1. The "clear" water (filtrate) flows by gravity to Lift Station No. 1 and is then pumped to the air stripper.

Lift Station No. 1

Lift Station No. 1 is a covered 3,000 gallon epoxy coated carbon steel tank equipped with level controls and alarms. The tank is covered for control of VOC emissions. This lift station is used to pump the filtrate from the sand filter to the top of the air stripper.

5) Air Stripping

Purpose: Removal of VOCs from the groundwater.

Air Stripper

An existing down-flow, counter-current air stripper is used in the stabilization system to remove VOCs from the groundwater. The air stripper has a surface area of about 3.1 square feet and a maximum loading rate of 90 gallons per minute (gpm). If the flow to the air stripper is going to exceed 90 gpm as a result of adding additional recovery wells to the groundwater capture system, a second similar unit will be added to handle the additional flow.

The contaminated vapor stream emerging from the top of the air stripping tower is directed to a dehumidifier to reduce relative humidity before being treated by the vapor-phase activated carbon system. Effluent groundwater from the air stripper flows by gravity to Lift Station No. 2.

Lift Station No. 2

Following air stripping, groundwater will flow by gravity to Lift Station No. 2. Lift Station No. 2 is a 1,000 gallon pre-cast concrete sump complete with control and alarms sawcut into the existing floor slab. The sump is covered with a Bilco-type hinged cover for control of VOC emissions.

Groundwater is pumped to the next (aqueous phase granular activated carbon adsorption) unit process from Lift Station No. 2.

6) Aqueous-Phase Activated Carbon Adsorption

Purpose: To provide additional polishing of the pretreated groundwater before final discharge to the City of Cranston POTW.

Aqueous Phase GAC

Two, 8-foot diameter epoxy coated carbon vessels will be installed. The carbon vessels have the capability of being operated in either parallel or series. Each vessel holds about 10,000 pounds of carbon and is designed for 180 gallons per minute. The activated carbon adsorption system is designed for backwashing to prevent solids from plugging the carbon media. The backwash water will flow directly to Equalization Tank No. 1. The drainage water generated during the carbon transfer will be conveyed to Lift Station No. 3 by gravity before being pumped back to Equalization Tank No. 1.

Lift Station No. 3

Lift station No. 3 is a 1,000 gallon pre-cast concrete sump sawcut into the existing floor slab. The sump will be covered for VOC control. This lift station will be equipped with a mixer and level controls. Process water from the sand filter backwash, sludge holding tank overflow, filter press filtrate, and floor drains will be conveyed from Lift Station No. 3 to Equalization Tank No. 1.

7) Final pH Adjustment System

<u>Purpose:</u> Adjust the pH to within the acceptable limits as specified in the POTW Industrial Wastewater Permit. The pH of the groundwater will be decreased to within permitted limits with sulfuric acid (H_2SO_4).

<u>Final pH Adjustment Tank</u>

An 8-foot diameter 3,000 gallon epoxy coated carbon steel tank will be used for final pH adjustment. This tank will be equipped with a chemical feed system, a mixer, and pH controls.

8) Effluent Flow Measurement, Totalization, and Recording

The following instrumentation will be provided on the effluent line:

- Magnetic flowmeter
- Flow totalizer/indicator/recorder

9) Effluent Sampling

An Isco automatic refrigerated composite sampler is provided on the effluent line.

Discharge to POTW

Pretreated groundwater is discharged to the City of Cranston POTW via an existing on-site sanitary sewer system connection.

B) Vapor-Phase Treatment

1) Dehumidification

Purpose: Moisture emitted from the air stripper is reduced to optimize the performance of the vapor-phase activated carbon treatment.

2) Vapor-Phase Activated Carbon Adsorption

Purpose: To provide treatment and odor control of the air discharged from the air stripper and select process tanks.

Vapor-Phase Activated Carbon

An epoxy lined carbon steel vessel with a capacity of 12,500 lbs. of granular activated carbon will be used for treating air prior to discharge to the atmosphere. Space for two vapor-phase activated carbon units will be provided; however, only one unit will be in operation at any one time. The unit will be replaced once breakthrough occurs. The air will be discharged to the atmosphere directly from the top of the vessel.

C) Sludge Handling

1) Sludge Holding/Thickening Tank

Purpose: To temporarily hold the sludge and allow it to thicken prior to dewatering.

Sludge Thickening Tank

A 6,000 gallon epoxy coated carbon steel tank with a conical bottom will be used for sludge thickening. This tank will be equipped with level controls. The overflow from the sludge thickening tank is allowed to flow by gravity to Lift Station No. 3, from which it is pumped to the Equalization Tank No. 1. The thickened sludge is pumped from the bottom of the tank to the filter press for dewatering using an air operated diaphragm pump.

2) Sludge Dewatering

Purpose: To reduce water content in the metal hydroxide sludge; thereby reducing the amount of sludge to be disposed. A sludge cake of about 30 percent dry solids content should be achieved before disposal.

Filter Press

A recessed plate filter press with a 25 ft^3 capacity will be used for sludge dewatering. Filtrate from dewatering will be conveyed to Equalization Tank No. 1 via Lift Station No. 3. Dewatered sludge will be disposed off site.

3.2.3 Soil Vapor Extraction System

The main design criteria for the soil vapor extraction (SVE) system is to reduce the level of organics in the soils at SWMU-11.

3.2.3.1 Description

The process and instrumentation (P&I) diagrams for the SVE system are presented in Drawing I-10 of Volume 4.

Groundwater and soil gas are extracted independently of each other from the SVE wells to optimize the overall system flexibility. This capability is necessary if the groundwater extraction system must continue to operate after the SVE system has been shut-down. Soil vapor extracted during stabilization will be treated by a thermal/catalytic oxidizer before being emitted to the atmosphere. Groundwater extracted during SWMU-11 stabilization will be conveyed to the groundwater pretreatment system. Exposed piping runs will be enclosed in a 3-sided fence from the SVE system to the north end of the Production Area, and then below grade to the groundwater pretreatment system.

3.2.3.2 Performance Standards

The following performance standards are used for measuring compliance with the design criteria:

- Discharge of treated air (i.e., soil gas) to comply with emission limits prescribed in an air discharge permit to be negotiated with RIDEM.

- Discharge of extracted groundwater to the groundwater pretreatment system is expected to be controlled by provisions of the Industrial Discharge Permit to be negotiated with the City of Cranston POTW.

- Soil gas extraction will continue until the concentration of VOCs in the extracted soil gas remains statistically flat (i.e., becomes asymptotic as determined by data regression) for six months, based on monthly soil gas quality analytical data.

- Groundwater extraction will continue until concentrations of VOCs in the extracted groundwater in each extraction well remain statistically flat (as determined by data regression) for four quarters based on quarterly groundwater quality monitoring analytical data.

3.2.3.3 Individual Units

The SVE system extracts groundwater and soil vapor in two separate streams from a well. Groundwater is extracted through a straw in the well, while soil vapor is extracted from the unsaturated zone soils by applying vacuum directly to the well riser.

- Extraction wells
- Vacuum pump system
- Vapor vacuum tank system
- Water extraction tank system
- Water discharge pumps

- Air purge vacuum pump
- Thermal/catalytic oxidizer
- SVE control system

Extraction Wells

The SVE system consists of seven wells in the SWMU-11 area. Wells VE-1, VE-2, VE-3, and VE-11 are designed to extract both soil vapor and groundwater. Wells VE-7, VE-9, and VE-10 are designed to extract groundwater only. Each of the seven extraction wells will be connected to the water and vapor extraction manifolds. A liquid level sensor will be used in each well to control automatically the water and vapor extraction manifold solenoid valves. The solenoid valves will control the extraction rates from the wells.

Vacuum Pump System

The vacuum pump on the SVE system is a positive-displacement rotary lobe-type vacuum blower. The system includes an inlet and exhaust silencer, and all piping which will exceed 120°F operating temperature is insulated. Instrumentation on the vacuum pump skid includes the following:

- Inlet temperature gauge
- Inlet vacuum gauge
- Exhaust temperature gauge
- Exhaust pressure gauge
- Outlet flow measuring device (annubar differential pressure gauge)

Vapor Vacuum Tank System

The vacuum pump draws pneumatic suction on a 120-gallon vapor vacuum tank, which is connected to the vapor extraction manifold and the wells. The vapor vacuum tank has a water sensor in its bottom which provides a signal to transfer the accumulated water to the water extraction manifold.

Water Extraction Tank System

Groundwater is extracted from the straw in the well by the vacuum generated in the 120 gallon water extraction tank system. The vacuum level maintained in this tank is in considerable excess of that maintained in the vapor vacuum tank, sufficient to extract fluids hydraulically. The system includes a vacuum switch to control the water discharge pumps, a high level water sensor to control the automatic operation of a small air purge vacuum pump which removes excessive air from the tank top (e.g., during start-up and in the event that an air leak occurs), and two low water level sensors to shutdown one or both of the water discharge pumps in the event that the water level in the tank gets low (e.g., air has entered the system, or during start-up). During normal operation of the system, the pumps produce and maintain the operating water vacuum, which is moderated by a small air pocket at the tank top, and the air purge vacuum pump only removes excessive air as necessary.

Water Discharge Pumps

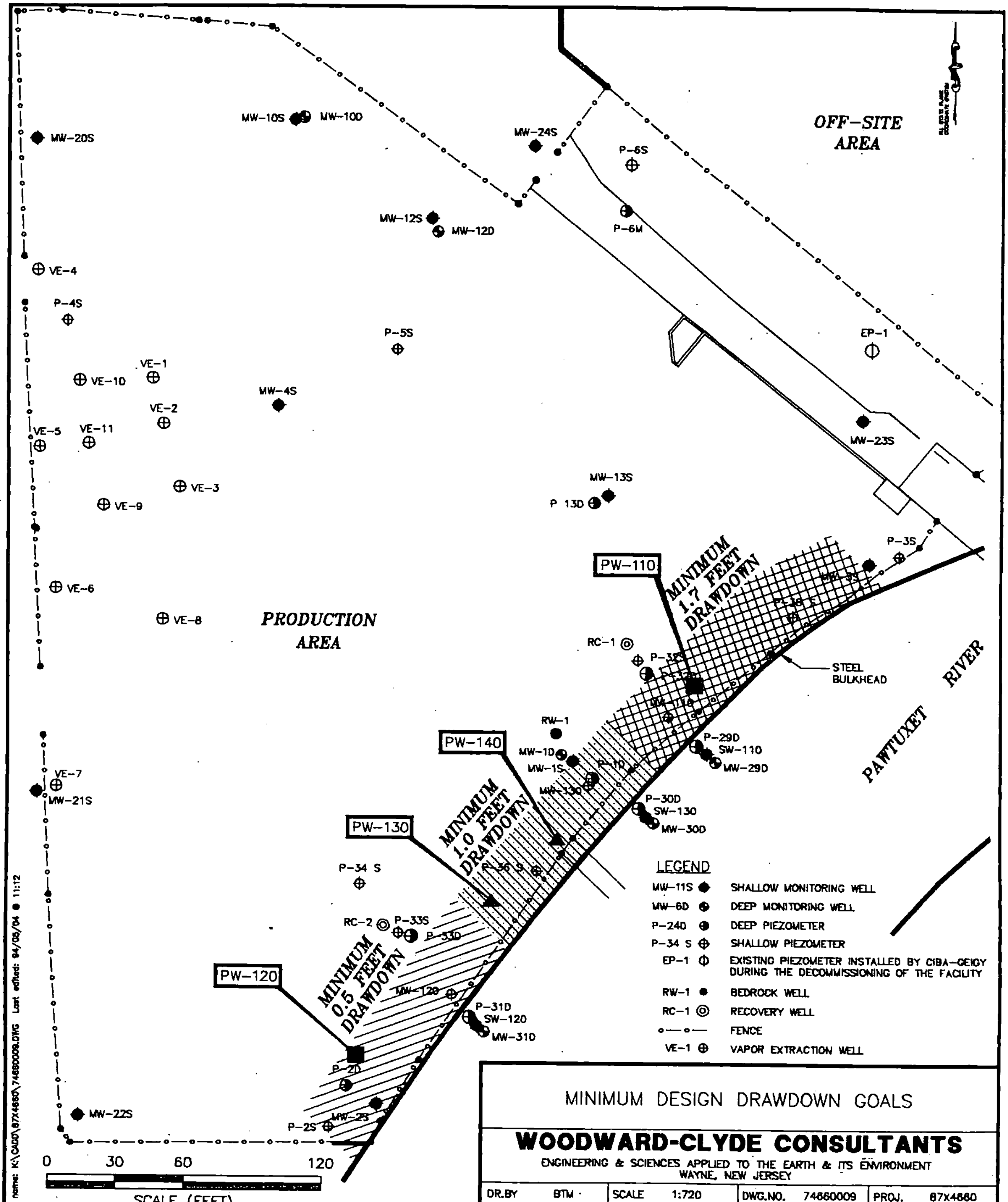
Progressive-cavity positive displacement pumps are used to transfer collected liquid from the water extraction tank to the groundwater pretreatment system, while creating and maintaining a vacuum (22 to 25 inches Hg) in the water extraction tank. The pumps are fitted with spring loaded check valves on the discharge connections and isolation ball valves on both the suction and discharge connections, a vacuum gauge on the suction header, combination gauge on the discharge header, and are fitted with a magnetic-type flowmeter/totalizer.

Thermal/Catalytic Oxidizer

As required to meet the anticipated air emission discharge requirements, a thermal/catalytic oxidizer will be installed to reduce the effluent contamination levels to the necessary limits. This device is set up to operate using natural gas, and is capable of handling 1000 ACFM inlet air. The unit is designed for ready changeover from thermal oxidation (LEL 80 percent maximum inlet concentration) to catalytic oxidation (LEL 25-30 percent inlet concentration), as the combustible vapor concentrations decrease with time. This system is fitted with an automatic dilution air valve controlled by a temperature sensor in the exhaust stack and a shutdown temperature sensor (maximum not to exceed exhaust temp).

SVE Control System

A suitable NEMA rated control panel with circuit-breaker disconnect, control transformer, motor starters, controls and indicators provides automatic and manual control of the complete system. The short-circuit protection and disconnecting device is a three-pole circuit breaker. The motor starters are across-the-line full voltage, non-reversing, magnetic starters with three ambient compensated overloads. The control circuit has an individual 120 volt fused secondary, grounded control power transformer and external reset buttons, start/stop buttons, and pilot lights.



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MINIMUM DESIGN DRAWDOWN GOALS

WOODWARD-CLYDE CONSULTANTS

ENGINEERING & SCIENCES APPLIED TO THE EARTH & ITS ENVIRONMENT
WAYNE, NEW JERSEY

DR.BY	BTM	SCALE	1:720	DWG.NO.	74660009	PROJ.	87X4660
CK'D.BY	CLH	DATE	JUNE 8, 1994	FIG.NO.	3-1		

Table 3-1
Proposed Performance Standards
Stabilization Action - Cranston, Rhode Island
Groundwater Pretreatment System
Aqueous-Phase Treatment

Parameter	Effluent Concentration (mg/l)
Antimony (total)	0.05
Arsenic (total)	0.1
Beryllium (total)	0.005
Boron (total)	1.0
Cadmium (total)	0.04
Chromium (total)	0.4
Copper (total)	1.0
Cyanide (total)	0.3
Iron (total)	2.0
Lead (total)	0.3
Manganese (total)	2.0
Mercury (total)	0.005
Nickel (total)	0.7
Phenols (total)	1.0
Selenium (total)	0.01
Silver (total)	0.1
Thallium (total)	0.005
Zinc (total)	1.0
Total Toxic Organics	2.13
Oil and Grease	25 Mineral/Petroleum Origin 100 Animal/Vegetable Origin
pH	5.5 to 9.5 units

Table 3-2
Proposed Performance Standards
Stabilization Action - Cranston, Rhode Island
Groundwater Pretreatment System
Vapor-Phase Treatment

Parameter	**Maximum Emission Rate (lb/hr)**
Acrylonitrile	0.004
Aniline	0.04
O-Anisidine	0.001
Antimony & Antimony Compounds	1.14
Arsenic & Arsenic Compounds	0.0
Benzene	0.005
Benzidine	0.0
Benzotrichloride	0.0
Benzyl Chloride	0.005
Cadmium & Cadmium Compounds	0.0
Carbon Tetrachloride	0.001
Chloroform	0.002
Chromium & Chromium Compounds	0.0
3,3'-dichlorobenzidine	0.0001
Dioctyl Phthalate	0.03
Diphenyl	0.02
Diphenyl Amine	1.14
Epichlorohydrin	0.04
Ethylene Dichloride	0.002
Ethylene Oxide	0.0005
Hydrazine	0.0
Hydrogen Chloride	1.14
Hydrogen Fluoride	0.1

Table 3-2 Proposed Performance Standards Stabilization Action - Cranston, Rhode Island Groundwater Pretreatment System Vapor-Phase Treatment	
Parameter	**Maximum Emission Rate (lb/hr)**
Lead	1.14
Manganese & Manganese Compounds	0.01
Methyl Cellosolve	1.14
Methylene Biphenyl Iscyante (MDI)	0.003
4,4'-Methylene bis(2-chloroaniliine)	0.05
Methylene Chloride	0.01
Nickel & Nickel Compounds	0.0001
5-Nitro (o-anisidine)	0.004
2-Nitropropane	0.01
Perchloroethylene	0.002
Styrene	1.14
Toluene	1.14
Toluene-2,4 Diisocyanate (TDI)	0.001
O-Toluidene	0.002
1,1,2 Trichloroethane	0.3
Trichloroethylene	0.02
Triethylamine	1.14
Xylene	1.14
Other Contaminants	10

Section 4

4.1 OVERVIEW

This sections presents information on the stabilization system's normal operation, monitoring, alternate operation, maintenance tasks, replacement and potential operating problems for the major equipment. Additional information will be added to this section once the final equipment has been selected and purchased.

4.2 EXTRACTION AND TRANSFER PUMPS

4.2.1 Normal Operation

All extraction pumps in the stabilization system are designed to run continuously. These pumps can be shut-down manually by the local H-O-A switch or by the low-level sensors. If the pumps are shut-down, they must be restarted manually.

All groundwater transfer pumps are designed to run continuously. These pumps can also be shut-down manually or automatically by their associated level sensors. If the pumps are automatically shut-down for an alarm condition, they must be restarted manually.

4.2.2 Monitoring

The operation of all pumps can be monitored at the main control panel, which has a display to indicate that each pump is operating. Visual inspection of all tanks, with respect to their level and flows, will also verify both the transfer and extraction pump operation.

4.2.3 Alternate Operation

The stabilization system was designed to run the both extraction and transfer pumps (A,B,C and D) continuously. Stand-by transfer pumps have been provided at most of the transfer locations. In the event that an extraction pump fails, the transfer pump will be shut-down when the low-level sensor in the equalization tank is activated. In the event that a transfer pump fails, the stand-by transfer pump should be started as not to flood the wet well.

4.2.4 Vulnerability

The pumping systems are vulnerable to pump failure. However, if any one pump fails, the stand-by transfer pump can be operated. If necessary, replacement pumps are readily available and require little lead time for delivery. For this reason any down time would be minimal. Proper upkeep and maintenance of systems must be followed to reduce the chance of system failure. A power failure would cause the entire plant to shut-down simultaneously. As a result, no major problems should occur.

4.2.5 Maintenance Tasks

The following routine maintenance tasks for the extraction and transfer pumps should be performed at the minimum frequencies indicated:

- Check the condition of piping, valves, level and pressure sensing probes quarterly.
- Submersible extraction pumps should be removed from recovery wells and inspected for worn impellers, obstructions, and corrosion annually.
- All pumps should be lubricated as required by manufacturer's literature.

4.2.6 Potential Operating Problems

Equipment and power failures are the operational problems that could impact the extraction and transfer of groundwater. Both of these problems have been covered in the section on alternate operation.

4.3 pH CONTROL/ADJUSTMENT SYSTEMS

4.3.1 Normal Operation

The primary operational requirement for the three pH adjustment systems in the groundwater pretreatment system is to maintain the pH and chemical metering pump controls at the proper conditions for automatic control of pH. This is accomplished by operating the pH controllers in the automatic mode at the proper pH set-point. It also requires that one of the two chemical metering pumps are energized and enable to operate in response to the pH controller output signal.

Except during start-up, there are no specific operational tasks associated directly with operation and control of the pH adjustment systems. During start-up it is necessary for some manual operation of the pH controllers to gradually bring the groundwater pH to the desired set-point. Once the actual pH is approached, the controller can then be placed in the automatic mode.

Because of the sensitive nature of the pH instrumentation, the most important operator involvement pertains to monitoring and maintenance. With adequate monitoring and maintenance, the pH adjustment systems should provide continuous, effective control of pH.

4.3.2 Process Monitoring

Process monitoring should be performed at a minimum on a weekly basis as follows:

- Verify operation of the chemical addition system metering pumps.
- Check chemical levels in the totes and chemical inventories weekly to ensure an adequate supply of chemicals. Order new totes as necessary to satisfy pH adjustment system requirements.
- Assess past pH controller performance by reviewing the pH recorder strip chart on the main control panel.
- Obtain a sample of groundwater from the deaeration/pH adjustment tank and the final pH adjustment tank and analyze them for pH using a standard bench-top pH measuring device. Compare the result to the control system reading.

4.3.3 Alternate Operation

Neither of the two pH adjustment systems includes back-up analyzers. Each of the chemical metering systems has a back-up metering pump. If one pump should fail, the second pump can be started and run in its place.

4.3.4 Vulnerability

On-line redundancy is not necessary and therefore not provided for either of the three pH adjustment systems. In the event of any equipment or instrument failure, the system components will go to a safe condition or shutdown until the problem is corrected by the operator. Routine monitoring should limit unscheduled emergency downtime periods.

4.3.5 Maintenance Tasks

The following routine maintenance tasks for the pH adjustment systems should be performed at the minimum frequencies indicated:

- Check the condition of piping, valves, tanks and other pertinent equipment quarterly.
- Perform general housekeeping monthly or more frequently as needed.
- Check and calibrate pH sensing instrumentation on a weekly basis.

4.3.6 Equipment Replacement

Except for the pH probes, the equipment used in the pH adjustment systems is designed for permanent installation, and given proper maintenance, their effective life should be indefinite. The pH probes consist of two glass electrodes that are somewhat delicate. They have a relatively short life, and therefore must be replaced annually, or as recommended by the manufacturer.

4.3.7 Potential Operating Problems

Potential operating problems that would impact the pH adjustment systems and preventative actions to address these problems include:

Potential Problem/Component	Preventative Actions
1. Equipment Failure	
· Chemical metering pumps	Redundant pumps provided
· Agitator	System shut-down
2. Instrument Failure	
· Controllers	None - controller fails to fixed output.
· Probes	Routine calibration and maintenance
3. Power failure	None - complete system shut-down
4. Precipitated solids handling problems (e.g. scaling)	Routine cleaning of critical components.

4.4 INCLINED PLATE SEPARATOR

4.4.1 Normal Operation

During normal operation of the inclined plate separator groundwater will continuously flow by gravity from the deaeration tank through the flash-mix tank, flocculation tank, inclined plate settler and gravity thickener. The flash-mix tank mixer, flocculation tank mixer, and sludge rake are all fixed-speed mixers and in operation at all times when the groundwater pretreatment system is in service.

4.4.2 Process Monitoring

Operation of the mixers and sludge rake should be verified. Indicator lights are present on the local control panels for this purpose. Jar testing and sludge settling tests to determine appropriate polymer dosage rates should be performed. Supernatant from the inclined plate settling tank may be monitored for total solids content (if desired) to verify that the system is operating correctly.

4.4.3 Alternate Operation

Alternate operation is not possible for these processes since redundant equipment is not provided. The plant may not operate intermittently, if the inclined plate separator must be taken out of service.

4.4.4 Vulnerability

A power failure would cause the entire system to shutdown, eliminating the need to operate the inclined plate separator. If the flash-mix tank mixer or flocculation tank mixer fail, the entire system must be shutdown. The mixers are essential to the flocculation process. If polymer is dosed incorrectly, poor settling may occur and excess solids may be sent to the downstream filtration process. Too much polymer may result in clogging of the inclined plate settler or the sand filter. If too much sludge is allowed to build up in the gravity thickener unit, a high level may be reached which would cause the sludge rake motor to overload and fail.

4.4.5 Maintenance Tasks

The following routine maintenance tasks should be performed at regular intervals as specified here or in accordance with the manufacturers' instructions:

- Lubricate the flash mix and flocculation tank mixers, and sludge drive motors as directed by the manufacturers' literature.
- Check condition of piping, valves, tanks, mixers, and rake for corrosion or possible leakage on a quarterly basis.
- Clean spilled polymer, sludge or other liquid as quickly as possible. Polymer is extremely slippery and could cause a safety hazard when allowed to remain on working surfaces.
- Drain the entire unit every two-years, clean, and check interior for corrosion.

4.4.6 Equipment Replacement

The equipment in this system is designed for permanent installation and continuous operation. When abnormal operating conditions occur, such as unusual noise, vibration or performance, the operator should further investigate to determine the cause of the problem. If corrective maintenance (in accordance with the manufacturer's instructions) does not correct the problem, replacement parts or equipment may have to be installed as recommended by the manufacturer.

4.4.7 Potential Operating Problems

Equipment and power failures effects on operation have been discussed under the vulnerability section. Improper polymer dosages have also been mentioned in that section.

4.5 SAND FILTER

4.5.1 Normal Operation

During normal operation, flow from the inclined plate separator will continuously flow through the sand filter by gravity. The unit constantly recycles sand internally and reject water is returned to Equalization Tank No. 1 via Lift Station No. 3. Iron floc and impurities are scoured loose from the sand by a combination of shear and abrasion forces during this turbulent upward flow in the airlift. Upon reaching the top of the airlift, the dirty slurry spills over into the central reject compartment. Sand is returned to the sand bed through the washer/separator. The washer/separator (used to further clean the sand) is placed concentrically around the upper part of the airlift and consists of a zig-zag flow channel. By setting the filtrate weir above the reject weir a small steady stream of clean filtrate flows upward through the washer/separator, countercurrent to the movement of sand. Within the washer/separator, the sand is cleaned further by fluid shear and sand abrasion. The removed impurities are discharged over the reject weir. Because the sand has a higher settling velocity than the removed impurities, it is not carried out of the filter.

The operating range for the continuous backwash system is determined by the air flow rate and the physical size of the washer section of the reject compartment. As the air flow rate to the airlift is reduced, a critical point is reached at which the buoyant force of fluid created by the airlift is insufficient to lift the sand. If sand is not transported up the airlift, the filter bed will not be cleaned and filter performance will ultimately deteriorate. Below the critical air flow rate, only water will be pumped up the airlift and the flow of reject water discharged from the filter will increase. As the air flow rate to the airlift is increased, the amount of sand lifted also increases until another critical operating point is reached. The upper limit of operation is defined by the sand flow rate which overloads the washer section to the point of ineffective cleaning. Beyond the upper operating limit the quality of the effluent, measured in terms of turbidity will also deteriorate. If enough sand is pumped, the washer can be clogged physically. Thus, the operating range for the air flow to the airlift must be defined for a given filter, but the operating range is sufficiently broad to handle variations in flow and suspended solids.

4.5.2 Process Monitoring

Filter effluent quality may be monitored for desired turbidity or solids levels. The filter reject rate may be adjusted accordingly, to achieve the desired effluent quality.

4.5.3 Vulnerability

A power failure would cause the entire system to shut-down, so operation of the sand filter would not be required. Redundancy has not been provided for the sand filter. A short-term shutdown of the sand filter should not adversely affect the downstream processes, unless the effluent is very turbid. The following air stripper and carbon adsorption systems might potentially see some clogging if a very turbid effluent were fed directly to them.

4.5.4 Maintenance Tasks

The sand filter requires very little maintenance as it contains no moving parts. Maintenance for the sand filter and associated equipment should include:

- Check the airlift pipe for wear. The airlift can be removed for inspection at any time without restricting the operation.

- Monitor media depth on a semi-annual basis to check that media is not being lost in the recycle flow.

Should the filtration unit need to be removed from operation and taken down for servicing, the unit is equipped with a valve at the bottom to allow the filter to be drained.

4.5.5 Equipment Replacement

The airlift is the only part of the filter which is subject to wear. The wear is restricted to the airlift pipe which can be removed and replaced. It is not expected that the other filter components will require replacement. Periodic inspection of the airlift will indicate when wear is significant enough that it should be replaced. Replacement should be made before part failure occurs, in accordance with the manufacturer's instructions.

4.5.6 Potential Operating Problems

If the compressed air supply is interrupted (while the filter will continue to operate) particles may be washed through the bed and discharged into the effluent. If the air supply is not sufficiently filtered, it may clog the flow line. This will result in fluctuating air supply for the airlift, which in turn affects recycle rate and effluent quality. Periodic cleaning of the compressor air filter should prevent this problem.

4.6 AQUEOUS-PHASE ACTIVATED CARBON

4.6.1 Normal Operation

One, Calgon Model-8 activated carbon adsorption unit will be in service at all times to provide polishing of the groundwater prior to discharge to the sanitary sewer. Groundwater will be pumped to the activated carbon unit following air stripping. All inlet and outlet valves should be automatically opened or closed depending on the operation being performed. All sample valves should be normally closed. Backwashing of the unit with City water has been provided to increase the "life" of the activated carbon.

4.6.2 Process Monitoring

The pressure indicator on the feed pipe may be monitored. If pressure begins to increase, fouling of carbon piping and/carbon beds may be occurring and backwashing may be required.

4.6.3 Alternate Operation

When breakthrough occurs, the carbon unit being used must be removed from service. The stabilization system should be shut-down during the carbon transfer. The stabilization system may be operated intermittently, during carbon replacement but only if the VOC concentration in the effluent is known to be low.

4.6.4 Vulnerability

A power failure would cause the entire system to shut-down, eliminating flow to the activated carbon units. Redundancy has been provided at this location. Two identical 10,000 pound activated carbon adsorption units are provided. The stabilization system may be operated with only one or both units in operation at any one time.

4.6.5 Maintenance Tasks

Carbon will have to be replaced when breakthrough occurs. Backwashing of the carbon beds will also have to be performed on a regular schedule. General maintenance activities include:

- Inspect condition of piping and valves for any leaks or corrosion on a quarterly basis.
- Clean any spilled liquid resulting from sampling or replacement of carbon as soon as possible.
- Perform general housekeeping as necessary.

4.6.6 Equipment Replacement

There is no schedule associated with equipment replacement for this unit process.

4.6.7 Potential Operating Problems

The breakthrough of organic compounds into the effluent is a potential operating problem. If this occurs, the carbon bed should be removed and replaced or flow should be transferred to the next available carbon unit. Monitoring the pressure indicator on the feed line should indicate if clogging is occurring and when backwashing will be required.

4.7 SLUDGE STORAGE/DEWATERING

4.7.1 Normal Operation

Sludge will be removed from the thickener unit of the inclined plate separator and pumped to the sludge storage tank. The sludge transfer pump will be operated intermittently, on a timer. A sludge recycle pump has been provided to convey a portion of the thickened sludge back to the head of the inclined plate separator to improve sludge setting. Operation of the sludge recycle pump also will be controlled on a timed basis.

4.7.2 Process Monitoring

Process monitoring consists of verifying that the sludge transfer and sludge recycle pumps are operating and that sludge levels in the settling tanks are under control. Laboratory testing for sludge handling is not required. The operation of the sludge recycle and transfer pumps can be verified at the main control system.

The sludge in the storage tank should be removed when the tank becomes half full or to a depth as determined by experience. Sludge will be dewatered using a recessed plate filter press.

4.7.3 Vulnerability

The sludge transfer system is relatively invulnerable to failure with the exception of the sludge transfer pump clogging. The system is not essential to the process. Short-term shutdown should not affect the treatment of groundwater. A power failure would cause the entire plant to shut-down, so operation of the sludge handling equipment would not be needed.

4.7.4 Maintenance Tasks

The following routine maintenance tasks for the sludge handling system should be performed at the minimum frequencies indicated:

- Check the condition of piping, valves, tanks (for corrosion), and other equipment quarterly.
- Perform general housekeeping monthly or more frequently as needed.
- Clean up any spilled sludge as soon as possible.
- Drain the sludge storage tank annually, clean it and check the interior for corrosion.

4.7.5 Equipment Replacement

The equipment used in the sludge handling system is designed for permanent installation and the type of service intended by the operation of the facility. A standby sludge recycle should be provided so that a pump failure does not adversely affect the operation of the stabilization system. If equipment problems develop, they will be identified during periodic, routine inspection of the facility by the operator. Repair or replacement of the equipment will be performed in accordance with the manufacturer's instructions.

4.7.6 Potential Operating Problems

Equipment and power failures are the operational problems that could impact the handling of sludge. Both of these problems have been covered in the section on alternate operation.

4.8 POLYMER ADDITION SYSTEM

4.8.1 Normal Operation

During normal operation the polymer unit will automatically operate when the groundwater pretreatment system is activated. The polymer addition system will automatically control the metering, dilution and feeding of liquid polymer to the stabilization system.

4.8.2 Maintenance Tasks

Typical operation and maintenance tasks for the polymer preparation system include the following:

- Verify the operation of all motor-driven equipment.
- Check the level in the concentrated polymer 55-gallon drum to verify that there is sufficient volume to operate for the week and over any holidays.
- Check the polymer stock to verify that there is sufficient chemical to operate the process until the next delivery.
- Order chemical with enough lead time to prevent running out of chemical before the next shipment arrives.
- Test the alarms monthly to verify that they are functioning properly.

4.9.3 Alternate Operation

As an alternate operating mode to the automatic mode, the polymer addition system can be operated in a manual mode. To switch the polymer feed system to manual the H-O-A switch located on the unit is placed in the "H" position. The operator must exercise caution when operating in the manual mode to avoid possible clogging of the inclined plate separator and sand filter due to excess polymer addition.

Section 5

5.1 OVERVIEW

This chapter preliminary presents recommended maintenance and repair guidelines for the stabilization system. Both plant operation and maintenance tasks are the responsibility of the plant operator(s).

5.2 GENERAL

For the stabilization to operate at peak efficiency, the equipment must be maintained in good operating condition at all times. Ideally, all equipment should be available for operation at any time. This would then enable routine equipment rotation, and maintenance would be more "Preventative" rather than on a "Corrective" or "Emergency" basis. Unfortunately, there are many conditions in a groundwater pretreatment system and/or soil vapor extraction system that can render the equipment inoperable. Therefore, the goal of following maintenance activities is to ensure that the equipment availability is as high as possible.

5.3 PERSONNEL

The part-time operating personnel must be capable of recognizing the warning signs of potential equipment failures before they happen. If not noted by the PLC control system, the operating personnel should have the knowledge to determine when a piece of equipment should be deactivated to prevent damage. They must also be capable of activating the backup equipment without causing damage to the system.

Operation and general maintenance of the facility will be performed by one part-time operator, with assistance by a second operator as needed or required by OSHA. The primary responsibilities of the operator(s) will be to ensure that chemical are stocked, collection of samples, sludge dewatering, carbon backwashing, the equipment is operating properly, and the process is functioning satisfactorily. Maintenance requirements include such items as routine preventive maintenance, pump lubrication, and corrective maintenance (when potential failure is indicated). Maintenance assistance may be employed as needed for any specialized equipment, such as the instrumentation and control system, to prevent process shutdowns.

5.4 MAINTENANCE RECORD SYSTEM

The following maintenance record keeping procedures should be utilized during operation of the stabilization systems to ensure that all historical maintenance data is kept and updated.

5.4.1 General

A good starting point for any record keeping system is a listing of the manufacturer's technical literature. This includes basic technical data such as equipment model numbers, part numbers, and spare parts, and spare part ordering information. The manufacturer's information should also lists the types of maintenance required for the equipment and the specific intervals. Following the manufacturer's periodic maintenance recommendations should allow you to maintain the equipment warranty intact, and achieve peak equipment performance.

Another basic piece of maintenance data is a listing of all historic events concerning each piece of equipment in the stabilization system. This information should include at a minimum, the equipment installation date, date checked-out by the manufacturer's representative, date tested, and date started under normal operating conditions. This data should enable the maintenance staff to log operation hours and establish historical patterns of equipment performance.

The maintenance record keeping system can be very elaborate or very simple depending on the function it is intended to provide. It should be regarded as a system to aid in the maintenance of the stabilization system and not a filing system that merely collects data.

Since the manufacturer's literature is normally quite lengthy, the record system should be designed as a "quick reference" system, listing only that information most frequently required. One method of such a system is a card system. Each card should contain such information as nameplate data, manufacturer's name, address, phone number, lubrication data, etc. Figure 5-1 shows a suggested discrepancy report to record problems that need correcting, and Figures 5-2 shows one possible arrangement.

5.4.2 System Updating

Whatever system is utilized, it should be kept up-to-date at all times. The responsibility of recording the actual maintenance should be assigned to a specific individual. A "Work Order Form" may be issued when a task is assigned and returned when complete. The maintenance functions can then be logged as complete, and a listing of materials used during the maintenance can be checked against inventory to determine when reordering is necessary.

Figures 5-1 through 5-3 are examples that could be utilized to document a maintenance history on a specific piece of equipment. They can be modified in any way but should retain enough information to identify the individual piece of equipment and the work performed.

5.4.3 Equipment Numbering System

In order to properly identify each piece of equipment in the stabilization system, and to be sure that maintenance is performed on the correct unit, each piece of equipment should be individually numbered. The numbering system employed will be consistent with the existing CIBA-GEIGY equipment numbering system.

5.5 INVENTORY AND STOCK REPLENISHMENT

The following guidelines should be helpful in setting up a stockroom and creating an inventory system for the stabilization systems.

- Thoroughly review the manufacturer's literature, estimated operating hours, historical data and procurement time. Following this review, a determination must be made as to what spare parts should be stocked.
- Minimum and maximum amounts of spare parts should be calculated based upon how many units utilize that particular part.
- Multiple sources as to where the items could be purchased should be located.
- Establish a re-order point, do not wait until the stocked item is completely depleted before reordering.
- Allow special consideration should be given to stocking equipment spare parts for singular process units that cannot be inoperable for extended periods.

With some consumable items, it is extremely difficult to estimate their future needs. Items such as miscellaneous nuts, bolts, washers, electrical supplies (tape, wire nuts, wire connectors) should be stocked and re-ordered on a regular basis. Figure 5-3 presents an example of a spare-parts inventory system.

5.6 MAINTENANCE SCHEDULE

5.6.1 General

Maintenance must be planned and scheduled to provide for even work loads. The size and complexity of the system and the type of personnel available will determine the kind of maintenance schedule necessary. Routine maintenance procedures fall into patterns. Certain items will have to be checked weekly, while others may only require monthly, semi-annually, or annually. Preventative maintenance tasks as normally recommended by the manufacturer and are routine. As a result, they can be scheduled. Even major repairs and new equipment installations can be scheduled. Proper maintenance scheduling requires considerations for personnel, equipment and materials.

5.6.2 Emergency Repairs

The goal of any maintenance program is to care for equipment in such a fashion that an emergency repair does not occur due to a failure. Nevertheless, emergency situations are expected to occur during the operating of the stabilization system. Basic emergency response procedures will be established, which include: 1) an immediate action plan; 2) contact list; 3) steps for process maintenance (if emergency occurs on critical sector of system); 4) process modifications and/or system shut-down procedures.

Some system failures will have multiple effects throughout the system. As a result, an "Emergency Response Program" will be developed.

5.7 MANUFACTURER SPONSORED MAINTENANCE COURSES

Many equipment manufacturers sponsor basic maintenance seminars to educate customers who have purchased their equipment. In most cases, these educational programs are offered at either little or no cost. The programs are designed for those individuals who are charged with maintaining the equipment and usually combines "classroom" with "hands-on" troubleshooting and repair. Most of the major equipment in the stabilization system has been specified to be provided with manufacturers training for the operating personnel.

5.8 SPECIALTY ITEMS

This sections is listed separately because special attention should be provided to these topics and in some applications, action is seldom taken until accidents or near accidents occur. Although they are maintenance related, some topics are combined safety/maintenance issues.

5.8.1 Electrical vs. Mechanical Maintenance

All too often mechanical maintenance is stressed above electrical maintenance, and electrical problems are corrected as they occur. Unfortunately, electrical problems are capable of causing fires and creating far more extensive damage. Some basic electrical maintenance items include:

- Electrical motors should be checked annually for "amperage draw" with a "meggar" device. Inconsistencies should be checked and corrected.

- Motor control centers (MCCs) and circuit-breaker panels should be de-energized and cleaned annually. Dust can build up on electrical contactors and cause faulty operation:

5.8.2 Valve Exercising

The valve exercising program should include each valve in the stabilization system that is not automatically controlled or does not get used on a regular basis. At a minimum, all valves should be exercised through their full range of "opened" and "closed" on an annual basis.

All gate valves should not be turned "full open" or "full closed" without reversing the valve direction about 1/4 to 1/2 of a turn. This procedures should help prevent "freezing" of the gate within the valve body.

5.8.3 HVAC Equipment

Beyond normal maintenance of changing filters and lubricating fan motors, the heating and ventilating (HVAC) system should receive an annual inspection. Normal wear and tear on motors as well as vibration of the ducting can promote the opening of seams and result in an overall "unbalancing" of the HVAC handling system. Manufacturer's literature will normally suggest the frequency of balancing the system. Balancing of the HVAC system should help add years of operating life to the HVAC electrical equipment.

FORMER CIBA-GEIGY FACILITY
CRANSTON, RHODE ISLAND

DISCREPANCY REPORT

Operator:	Report No.
Unit:	Date:
Location:	
Description of Problem:	
Action Taken:	
Maintenance Performed:	
Signature:	
Date Completed:	

Figure 5-1

FORMER CIBA-GEIGY FACILITY
CRANSTON, RHODE ISLAND

MAINTENANCE RECORD CARD

Equipment Description & No.	
Model No.	**Spare Parts**
Serial No.	
Location:	Number and Description
Manufacturer:	
Equipment Data:	

Figure 5-2

FORMER CIBA-GEIGY FACILITY
CRANSTON, RHODE ISLAND

SPARE PARTS INVENTORY

Part		Received		Used		Number In Stock
Number	Description	Date	Number	Date	Number	

Additional Information:

Section 6

6.1 OVERVIEW

This section includes information on chemical control procedures, sampling procedures, and on-site and off-site testing procedures

6.2 CHEMICAL CONTROL

This section covers control of chemical dosage by describing the methods of controlling the various chemical additional systems, by summarizing chemical data needed in calculations, and by showing how to perform the required chemical dosage calculations. It is recommended that the manufacturer's data be consulted for more detailed information about the operation of specific equipment. Chemical suppliers also can provide information on the chemicals used in the stabilization system and are required by law to provide a copy of the "material safety data sheet" (MSDS) for each of the products that they provide.

6.2.1 Chemical Feed Systems

There are four different chemicals used in the stabilization system including sodium hydroxide, sulfuric acid, hydrogen peroxide and polymer. These chemicals are all injected into the pretreatment system in the form of a liquid solution. All of the above chemical are to be purchased in 300 gallon totes with the exception of the polymer which will be supplied in 55 gallons drums.

Control of chemical dosage depends on the control of the chemical feed systems and especially the chemical feed pumps. The feed systems for addition of sodium hydroxide, hydrogen peroxide and sulfuric acid are all identical in function. The polymer addition system is different from these and is a pre-engineered package system.

The chemical metering pumps for the addition of sodium hydroxide, hydrogen peroxide and sulfuric acid all have one controllable feature, the stroke length setting as a fraction of full stroke. One full stroke length of the pump will deliver a fixed volume of chemical to the pretreatment system. A fractional stroke length will also deliver a fixed volume of chemical, but proportionately less than the full stroke. The stroke setting is shown on a micrometer at each pump and can be increased or decreased depending on the flowrate of chemical addition required.

The polymer addition system utilizes a packaged pumping and dilution system. The polymer addition unit automatically dilutes the "neat" (pure) polymer and pumps it to the inclined plate separator.

6.2.2 Chemical Dose Calculations

One method of determining the correct chemical dose is to perform a jar test. Jar tests are performed using several different chemical doses. The chemical dose that gives the best results, will then be used to calculate the amount of chemical to be added to the pretreatment system to obtain the same results. The procedure for running jar tests is described later in this chapter.

The correct chemical dose can be determined by using the following method:

STEP 1 *CALCULATE THE AMOUNT OF CHEMICAL NEEDED PER DAY.*

Amount of Chemical Needed Per Day (lbs) = Dose (mg/L or ppm) x Flow (MGD) x 8.34

STEP 2 *CALCULATE THE GALLONS PER HOUR THAT THE CHEMICAL FEED PUMP MUST SUPPLY.*

As part of this step, the strength of the chemical to be added must be known. The chemical flow in gallons per day is calculated from the amount of chemical needed (lb/day) divided by the solution strength (lb/gal) of the chemical to be added to the pretreatment system. This result is then divided by 24 to covert the flow from gal/day to gal/hr. The entire calculation is as follows:

Gallons per hour (gal/hr) = lb/day/strength in lb/gal/ 24 hr/day

STEP 3 *ADJUST THE PUMP STROKE SETTING TO OBTAIN THE CORRECT CHEMICAL FEED RATE.*

The pump adjustment is based on pre-determined calibration curves or on measurement of chemical flow rate after the stroke is adjusted.

6.2.3 Calibration Curves

Calibration curves for the chemical metering pumps can be prepared to show the correlation between pump stroke and chemical flow rates (gal/hr) for various plant flow rates. The calibration curves should be checked quarterly, because pump wear can reduce chemical flow and change the pump output.

6.2.4 Chemical Flow Measurement

As an alternative method to using calibration curves, the chemical flow can be measured directly using the calibration kit. This measurement should be made after each stroke length adjustment. The stroke length should be changed until the desired chemical flow rate is obtained at a constant pump speed. It is good practice to check the chemical flow rate when making stroke length adjustments based on calibration curves.

As an alternative to using the calibration kit, a sample of chemical may be collected from the pump discharge over a timed period to determine the flow per minute or hour. Care should be taken when collecting samples or checking calibration to avoid possible exposure to chemicals. Protective clothing, safety glasses, and gloves should be worn at all times.

6.2.5 Jar Testing

Jar testing is performed to determine the optimum chemical dose required. All jar tests results should be confirmed by field verification.

Equipment for Jar Test

The equipment requirements associated with jar testing are dependent upon the treatment objectives and the water quality parameters of concern. The principal equipment required to conduct the jar test includes:

- One, Six Station Gang Mixer.
- Eight, 1-liter Beakers.
- One, 5-Liter Beaker or Bottle.
- One, Illuminated Base (preferred, but not required).
- Stock Chemical Solutions
- One, Magnetic Stirrer Base
- Magnetic Stirring Bars (1 dozen)
- Two, 1-Liter Volumetric Flasks.

Preparation of Chemicals

Solutions of sodium hydroxide (NaOH) and sulfuric acid (H_2SO_4) must be prepared in concentrations suitable for use in jar testing. The small quantities of water that are utilized during jar testing necessitate that the chemical stock solutions be diluted.

For jar testing requiring NaOH, a 0.1 Normal (N) solution of sodium hydroxide is generally sufficient for pH adjustment. Reagent grade sodium hydroxide is usually supplied in pellet form and must be diluted. To prepare a 0.1 N solution the following procedure should be followed:

(1) Add 200 to 500 ml of distilled water to a clean volumetric flask.

(2) Drop in a magnetic stirring bar and place the flask onto a magnetic stirrer.

(3) Weigh out 4 grams of sodium hydroxide pellets onto an aluminum or plastic weighing dish.

(4) Pour all of the pellets into the volumetric flask. Mix at medium speed until all of the pellets dissolve.

(5) Remove the magnetic stirring bar and fill the volumetric flask to the mark with distilled water.

(6) Cap and shake for at least one minute.

(7) The strength of the stock solution will be 4000 mg/l or 4 mg/ml as 100% NaOH. Therefore, 1 ml added to a 2 liter jar will be equivalent to a dose of 2 mg/l.

For jar testing requiring sulfuric acid, a 0.1 N solution of sulfuric acid is generally sufficient for pH adjustment. Reagent grade sulfuric acid is usually supplied in liquid form. This preparation requires dilution of 99% sulfuric acid. To prepare a 0.1 N solution of sulfuric acid the following procedure should be followed:

(1) Add 200 to 500 ml of distilled water to a clean volumetric flask.

(2) Drop in a magnetic stirring bar and place the flask onto a magnetic stirrer.

(3) Pipette out 2.7 ml of 99% sulfuric acid.

(4) Place the measured amount of sulfuric acid into the volumetric flask. Mix at medium speed for about 1 minute.

(5) Remove the magnetic stirring bar and fill the volumetric flask to the mark with distilled water.

(6) Cap and shake for at least one minute.

(7) The strength of the stock solution will be 4900 mg/l or 4.9 mg/ml as H_2SO_4. Therefore, 1 ml added to a 2 liter jar will be equivalent to a dose of 2.45 mg/l.

<u>pH Adjustment Using NaOH or H_2SO_4 Procedure</u>

(1) Remove jars from gang stirrer and pour off supernatant in each jar into additional

1-liter jars (remember to label the additional jars accordingly).

(2) Place a magnetic stirring bar into each jar and place one of the jars on the jars on the magnetic stirrer. Run the stirrer on medium speed.

(3) While continuously monitoring the pH, Slowly add 0.1 N NaOH or H_2SO_4 with a pipet until a pH of 7.0 is reached. Record the amount of NaOH or H_2SO_4 needed.

(4) Continue the same pH adjustment for the remaining jars at different pH values (6.5, 7.5, 8.0).

<u>NaOH Feed Rate Calculation</u>
Using the NaOH stock solution concentration and the current flow rate of the treatment system, the feed rate can be calculated using the following formula:

Feed Rate of NaOH (gph) = Volume of Stock NaOH Needed in Jar Test (ml) x Concentration of Stock NaOH (mg/ml) x Pretreatment System Flow Rate (gpm) x 2.46 x 10-5

<u>H_2SO_4 Feed Rate Calculation</u>
Using the H2SO4 stock solution concentration and the current flow rate of the treatment system, the feed rate can be calculated using the following formula:

Feed Rate of H_2SO_4 (gph) = Volume Stock H_2SO_4 Needed in Jar Test (ml) x Concentration of Stock H_2SO_4 (mg/ml) x Pretreatment System Flow Rate (gpm) x 3.52 x 10-5

6.3 LABORATORYANALYSIS

Both on-site and off-site laboratory analysis of samples at selected locations within the stabilization system will provide the engineering data necessary for evaluation of the treatment process. Additional information on the specific laboratory analysis to be performed will be provide once the requirements of the groundwater pretreatment system's discharge permit and the SVE system's air discharge permit have been obtained. In general, all analysis required to be submitted to either the State of Rhode Island Department of Environmental Management (RIDEM) or the City of Cranston will be performed a laboratory certified by the State of Rhode Island.

6.4 SAMPLING

"Representative" samples is key in obtaining good laboratory testing results. "Representativeness" of sample means the sample obtain from the stabilization system truly reflects the quality and characteristics of the stream that is sampled. Good sampling requires proper sampling techniques, proper handling of samples, and proper storage techniques. Both grab and composite samples are anticipated for the stabilization system. Both types of sampling is discussed below.

6.4.1 Grab Samples

Grab samples are collected instantaneously from one location. A grab sample represents the condition that exists only at the time the sample was collected. Grab samples are taken for any of the following reasons:

- When samples must be analyzed immediately for constituents such as: pH, and temperature, and;
- When analytical results are required immediately and time is not available to collect a composite sample.

6.4.2 Composite Samples

A composite sample consists of a combination of grab samples that are taken over a period of time. Composite samples represent average water quality conditions over the sampling period. Most analyses required to be submitted to RIDEM and the City of Cranston (with the exception of VOCs which must be obtained by grab samples) must be based on composite samples. For the stabilization system, all composite samples will be performed over a 24-hour period in intervals of 1-hour or less. The samples will be collected using a refrigerated Isco sampler. Samples for VOCs will require that grab samples be obtained. VOC samples will be obtained during average operating conditions.

6.4.3 Sampling Technique

Grab samples should be obtained at a location where either the groundwater or sludge stream to be sampled is well mixed. All composite samples will be obtained automatically by the Isco samplers. Exclude all floating material, "scrapings" from the sides of tanks, and any material larger than one-quarter inch in size.

6.4.4 Sample Handling

Samples should be collected and stored in clean containers. Samples taken for the purpose of measuring pH and temperature must be analyzed immediately and if possible, at the location where they are taken. All other samples should be refrigerated at 4°C until they are analyzed. Precise procedures for sample storage methods and holding times are contained in the 17th edition of Standard Methods for the Examination of Water and Wastewater.

Section 7

FUNCTIONAL SPECIFICATION

PART 1 GENERAL

1.01 SUMMARY

A. This Section describes the Process Instrumentation and Control Systems (PICS) for the Final Stabilization Action at the Ciba-Geigy Facility, Cranston, Rhode Island. The intent of this Section is to supplement, where applicable, other Sections of Division 13, and amplify information contained in other sections.

1.02 FUNCTIONS

A. The primary function of the PICS shall be to provide centralized control and monitoring of each unit process for the treatment of extracted ground water. Each PICS will communicate to the Building 15 Control Room to provide visual and audible information on operating parameters, equipment status, and alarm conditions.

B. Major constituents of the PICS include an Analog Subsystem (AS), a Programmable Controller Subsystem (PCS), and Supervisory Computer and Data Aquisition system (SCADA).

1.03 CONTROL PHILOSOPHY

A. For control purposes, the ICS shall be divided into the following seven (7) Unit Processes:

1. Pumping Wells for Ground Water Extraction
2. Equilization
3. Air Oxidation and pH Adjustment
4. Clarification and Sand Filtration
5. Air Stripping
6. Granulated Activated Carbon Treatment (GAC)
7. Sludge Disposal

B. The PICS shall be designed to run automatically with minimal operator interface. However, the capability shall be provided for limited local manual control of system operations. Critical functions and changes to the system configuration shall be permitted only after verification of security passwords.

1.04 FUNCTIONAL REQUIREMENTS

A. General:

1. The ICS shall provide all of the functions described herein for each Unit Process. Major equipment items are specified for each Unit Process, however all items of equipment necessary to implement the required Unit Process performance shall be provided.

B. Format:
   1. Functional requirements are grouped by Unit Process.
   2. Each Unit Process is divided into four subheadings: Overview, Analog/Digital Subsystem Functions, Programmable Controller Subsystem Functions, Supervisory Control and Data Acquisition System Functions.
   3. The Analog/Digital Subsystem Functions subheading is further divided into two sections: Sensors/Transmitters and Control.
   4. The Programmable Controller Subsystem Functions subheading is further divided into four sections: Control, Data Acquisition, Interlocks, and Alarms

C. Components:
   1. Analog Subsystem:
      a. Overview - Process Sensor/Transmitter Instruments: Process sensor/transmitter instruments shall measure pressure, pH, level and flow for Unit Processes 1 to 8 as specified herein. The instruments shall have the capability of communicating using the "HART" protocol for the purpose of transmitting process information and instrument status as well as providing a means for remote calibration. If "HART" compatible devices are not available, the specified instrument shall transmit a 4-20mA dc signal in linear proportion to the measured variable. The devices shall conform to the individual instrument specifications described in subsequent sections of Division 13.

   2. Programmable Controller Subsystem:
      a. Overview - Programmable Logic Controller (PLC): The Programmable Logic Controller shall provide all functions for Unit Processes 1 to 8 as specified herein and as shown on the Drawings including:
         (1) Execution of the appropriate PID loop control algorithm;
         (2) Data acquisition from process sensors and conversion to engineering units;
         (3) Totalization of elapsed run time for all equipment items that have an ON/OFF status;
         (4) Alternation of the lead pumps in the appropriate sumps at a preselected interval;
         (5) Primary alarm detection and logging; and
         (6) Interfacing with and supporting the Supervisory Control and Data Acquisition System.

      b. Overview - Operator Interface (OI)
         The Operator Interface shall provide local

   3. Supervisory Control and Data Acquisition System:
      a. Overview: The Supervisory Control and Data Acquisition System (SCADA) shall consist of a Digital Equipment Corporation mini-computer running the Wonderware InTouch process monitoring and control software package under the Microsoft Disk Operating System (MS-DOS) and Windows Graphical User Interface program. The computer shall communicate to the PLC over a Modbus Plus link using a communications adapter board and software supplied by the PLC manufacturer. The InTouch

software package shall provide a driver to read and write data to the PLC over the Modbus Plus link. The software package shall also act as the primary method of operator interface with the PLC through the means of keyboard, function keys and graphic displays (Man-Machine Interface (MMI)). The MMI shall perform the following specific tasks:

(1) Display at operator's request operational status of Unit Processes, Unit Process data, alarm indication, and alarm logging;
(2) Provide operator access, using a minimum of keystrokes, to modify parameter values, change the status of ON/OFF equipment when required, and to acknowledge alarms;
(3) Provide password protection to prevent entering of unauthorized changes;
(4) Display real-time trends of all analog/digital process data over an eight hour interval;

The SCADA functions shall perform the following specific tasks:

(1) Update the internal process database continually by scanning PLC input and output registers;
(2) Display information from the process database automatically on user created color graphic displays;
(3) Produce alarm messages based on specific conditions that occur in the process data base;
(4) Produce historical trend graphs on user selected data samples from the process data base; and
(5) Generate a user customized report, either on demand or automatically, and direct the report to the video screen, the system printer, to a disk storage file, or other suitable output device.

D. Unit Process 1 - Pumping Wells for Ground Water Extraction (P&ID I1)

1. Overview

a. The Pumping Wells for Ground Water Extraction shall deliver extracted ground water into Equilization Tank T-300 via a 4" forced main header at an expected combined average flow rate of 60 gallons per minute (gpm) to a maximum of 90 gpm. Flow control from the individual Pumping Wells (PW) shall be accomplished by modulating an electrically actuated level control valve (LCV) to maintain a differential setpoint level between the Monitoring Wells (MW) and Stream Wells (SW).

b. The Pumping Wells for Ground Water Extraction Unit Process shall consist of two pumping wells (PW-110 and PW-120), two moniroting wells (MW-110 and MW-120), two stream wells (SW-110 and SW-120), two submersible well pumps (P-110 and P-120), six continuous level transmitters (LT-110A, LT-110B, LT-110C, LT-120A, LT-120B, and LT-120C) two level switches (LS-110 and LS-120), two pressure control valves (PCV-110 and PCV-120), two flow transmitters (FT-110 and FT-120), two pressure transmitters (PT-110 and PT-120), two pressure indicators (PI-110 and PI-120), two level control valves (LCV-110 and LCV-120), two electric actuators

(ZY-110 and ZY-120), and eight hand switches (HS-110A, HS-110B, HS-110C, HS-110D, HS-120A, HS-120B, HS-120C, HS-120D).

c. Water from Pumping Well PW-110 shall be delivered at a rate sufficient to maintain a differential setpoint level between Stream Well SW-110 and Monitoring Well MW-110 of 1.7 feet as monitored by continuous level probes LT-110C and LT-110B, respectively.

d. Water from Pumping Well PW-120 shall be delivered at a rate sufficient to maintain a differential setpoint level between Stream Well SW-120 and Monitoring Well MW-120 of 0.5 feet as monitored by continuous level probes LT-120C and LT-120B, respectively.

2. Analog/Digital Subsystems Functions:
   a. Sensors/Transmitters:
      Measure the following parameters and transmit a digital signal to the local PCS (where XXX refers to the equipment/instrument at the appropriate well location):
      (1) Level of Pumping Well (LT-XXXA).
      (2) Level of Monitoring Well (LT-XXXB).
      (3) Level of Stream Well (LT-XXXC).
      (4) Flow rate of extracted groundwater from Pumping Well (FIT-XXX)
      (5) Position of level control valve (LCV-XXX)
      (6) Pumping Well discharge pressure (PT-XXX)

   b. Control:
      (1) Input HAND and AUTO selection for each pump motor (HS-XXXB).
      (2) Input ON selection for each pump motor (HS-XXXC).
      (3) Input OFF selection for each pump motor (HS-XXXD).
      (4) Input FIELD DISCONNECT status for each pump motor (HS-XXXA).
      (5) Input status of each pump motor starter auxillary (YY-XXX) at Motor Control Center (MCC) PCS.
      (6) Input status of shelter security switch (YS-XXX).
      (7) Input status of Level Control Valve (LCV-XXX).
      (8) Input status of Pumping Well Level Transmitter (LT-XXXA).
      (9) Input status of Monitoring Well Level Transmitter (LT-XXXB).
      (10) Input status of Stream Well Level Transmitter (LT-XXXC).
      (11) Input status of Flow Indicating Transmitter (FIT-XXX).
      (12) Input status of Pressure Transmitter (PT-XXX).

3. Programmable Controller Subsystem Functions:
   a. Control:
      (1) If AUTO selected, provide ON-OFF function to Pump motor P-XXX.
      (2) Provide feedback control of Well Pump P-XXX flow by transmitting a digital signal to LCV-XXX based on differential level of LT-XXXC and LT-XXXB. Feedback control loop shall have two modes: MANUAL and AUTO. In

AUTO, level control valve position shall be adjusted until the differential level, as determined by measuring Stream Well level at LT-XXXC and Monitoring Well level at LT-XXXB, equals the setpoint. In MANUAL, level control valve position shall be adjusted by manually varying the loop output digital signal.

(4) Totalize runtime in minutes for pump P-XXX
(5) Provide means to reset each runtime totalizer if reset function selected.
(6) Provide failure indication output if pump P-XXX stops running when it is supposed to be in run state.
(7) Provide failure indication output if level contrl Valve LCV-XXX fails to travel to desired position.
(8) Provide indication output if LT-XXXA status changes.
(9) Provide indication output if LT-XXXB status changes.
(10) Provide indication output if LT-XXXC status changes.
(11) Provide indication output if FIT-XXX status changes.
(12) Provide indication output if PT-XXX status changes.
(13) Provide indication output if LCV-XXX status changes.

b. Data Aquisition:
Monitor the following parameters:
(1) HAND and AUTO selection indication for Pump P-XXX (HS-XXXB)
(2) Motor starter status for Pump P-XXX (YY-XXX) at MCC PCS.
(3) Local FIELD DISCONNECT status for Pump P-XXX (HS-XXXA).
(4) ON selection indication for Pump P-XXX (HS-XXXC).
(5) OFF selection indication for Pump P-XXX (HS-XXXD).
(6) Shelter security switch status for Pumping Well Enclosure XXX (YS-XXX).
(7) Status of LT-XXXA.
(8) Status of LT-XXXB.
(9) Status of LT-XXXC.
(10) Status of FIT-XXX.
(11) Status of PT-XXX.
(12) Status of LCV-XXX.

Scale to engineering units and store in memory:
(7) Pumping Well Level, LT-XXXA.
(8) Monitoring Well Level, LT-XXXB.
(9) Stream Well Level, LT-XXXC.
(10) Pumping Well Flow Rate, FIT-XXX
(11) Pumping Well Discharge Pressure, PT-XXX
(12) Level Control Valve Position, ZT-XXX.

c. Interlocks:
(1) Close LCV-XXX if: Pump P-XXX motor starter status (YY-XXX) off.
(2) Stop Pumping Well pumps (P-110 or P-120) if: Equilization Tank Level (LT-300) high high.

d. Alarms:
(1) Pumping Well Level (LT-XXXA) high.
(2) Pumping Well Level (LT-XXXA) high high.
(3) Pumping Well Level (LT-XXXA) low.
(4) Pumping Well Level (LT-XXXA) low low.

(5) Monitoring Well Level (LT-XXXB) high.
(6) Monitoring Well Level (LT-XXXB) high high.
(7) Monitoring Well Level (LT-XXXB) low.
(8) Monitoring Well Level (LT-XXXB) low low.
(9) Stream Well Level (LT-XXXC) high.
(10) Stream Well Level (LT-XXXC) high high.
(11) Stream Well Level (LT-XXXC) low.
(12) Stream Well Level (LT-XXXC) low low.
(13) Differential Level high.
(14) Differential Level high high.
(15) Differential Level low.
(16) Differnetial Level low low.
(17) Pumping Well Flow (FIT-XXX) high.
(18) Pumping Well Flow (FIT-XXX) high high.
(19) Pumping Well Flow (FIT-XXX) low.
(20) Pumping Well Flow (FIT-XXX) low low.
(21) Pumping Well Discharge Pressure (PT-XXX) high.
(22) Pumping Well Discharge Pressure (PT-XXX) high high.
(23) Pumping Well Discharge Pressure (PT-XXX) low.
(24) Pumping Well Discharge Pressure (PT-XXX) low low.
(25) Level Control Valve Position (ZT-XXX) failure.
(26) Pumping Well Level Transmitter (LT-XXXA) status change .
(27) Monitoring Well Level Transmitter (LT-XXXB) status change.
(28) Stream Well Level Transmitter (LT-XXXC) status change .
(29) Pumping Well Discharge Pressure Transmitter (PT-XXX) status change.
(30) Pumping Well Flow Indicating Transmitter (FIT-XXX) status change.
(31) Level Control Valve (LCV-XXX) status change.
(32) Pump P-XXX motor starter tripped.

4. Supervisory Control and Data Aquisition System Functions:
The Man-Machine Interface (MMI) function of the SCADA system shall display the following information:
(1) Process control loop parameters and mode.
(2) Mode and status of pump P-XXX
(3) Analog values of parameters listed in paragraph 3b items 7 to 12.
(4) Display cummulative run times of Pump P-XXX.
(5) Display alarm indications as listed in paragraph 3d. Provide means for alarm acknowledgement.
(6) Provide operator interface to:
Activate ON-OFF function to pump P-XXX;
Change differential flow control loop parameters and mode;
Reset run time totalizer of pump.
(7) Provide real time trends of analog parameters listed in paragraph 3b items 7 to 12.
(8) Provide real time trend of differential level control loop output.

All Unit Process parameters listed in paragraph 3b and alarms listed in paragraph 3d shall be made available over the communication link to the host computer and the WONDERWARE graphical process interface software.

E. Unit Process 2 - Equilization (P&ID I2)

1. Overview
   a. The Equilization Unit Process consists of two tanks to receive the extracted ground water from Unit Process 1 and the ground water obtained from the Soil Vapor Extraction (SVE) Unit Process (See ABCDEFG for description of SVE system). The flow of ground water from the Equilization Unit Process tanks is delivered at a rate sufficient to maintain at a setpoint level in each tank. Flow from the first floor tanks is delivered to the second floor Air Oxidation and pH Adjustment Unit Process (Unit Process 3) via a 4" carbon steel (CS) line. The ratio, at which the tank effluents are delivered, is determined by the Organic Analyzer monitoring the influent to the Air Stripper. An increase or decrease in organic concentration will result in an adjustment to this ratio to maintain a desired organic content in the Air Stripper influent.

   b. The Equilization Unit Process shall consist of the extracted ground water tank (T-300) and SVE ground water tank (T-320), two side entry mixers (A-300 and A-320), three pumps (P-310, P-311, and P-330), two level transmitters (LT-300 and LT-320), two level switches (LS-300 and LS-320), seven pressure indicators (PI-300, PI-310A, PI-310B, PI-311, PI-320, PI-330A, and PI-330B), two pressure transmitters (PIT-310 and PIT-330), two flow indicating transmitters (FIT-300 and FIT-320), two level control valves (LCV-300 and LCV-320), two electric actuators (ZY-300 and ZY-320), and twenty hand switches (HS-300A, HS-300B, HS-300C, HS-300D, HS-310A, HS-310B, HS-310C, HS-310D, HS-311A, HS-311B, HS-311C, HS-311D, HS-320A, HS-320B, HS-320C, HS-320D, HS-330A, HS-330B, HS-330C, HS-330D).

   c. The ratio of the combined effluents from tanks T-300 and T-320 shall be maintained based on the concentration of organics in the Air Stripper feed as determined by the Organic Monitor (AIT-611 - P&ID I6, Unit Process 6). The ratio of the effluents shall be maintained by modulating level control valves LCV-300 and LCV-320.

   d. The level of tanks T-300 and T-320 shall be maintained at setpoint conditions, in conjunction with the variable ratio of the effluent streams, by monitoring the level continuously at LT-300 and LT-320, respectively, and adjusting the flow rate accordingly to a maximum of 90 gpm.

2. Analog Subsystems Functions:
   a. Sensors/Transmitters:
      Measure the following parameters and transmit a digital signal to the local PCS:
      (1) Level of Tank T-300 (LT-300).
      (2) Level of Tank T-320 (LT-320).
      (3) Discharge Pressure of either Pump P-310 or P-311 (PT-310).

(4) Discharge Pressure of Pump P-330 (PT-330).
(5) Effluent flow rate of Tank T-300 (FIT-300).
(6) Effluent flow rate of Tank T-320 (FIT-320).
(7) Position of T-300 Level Control Valve (LCV-300).
(8) Position of T-320 Level Control Valve (LCV-320).

b. Control:

(1) Input HAND and AUTO selection for agitator motor A-300 (HS-300B).
(2) Input ON selection for agitator motor A-300 (HS-300C).
(3) Input OFF selection for agitator motor A-300 (HS-300D).
(4) Input FIELD DISCONNECT status for agitator motor A-300 (HS-300A).
(5) Input status of agitator motor A-300 starter auxillary (YY-300) at Motor Control Center (MCC) PCS.
(6) Input HAND and AUTO selection for agitator motor A-320 (HS-320B).
(7) Input ON selection for agitator motor A-320 (HS-320C).
(8) Input OFF selection for agitator motor A-320 (HS-320D).
(9) Input FIELD DISCONNECT status for agitator motor A-320 (HS-320A).
(10) Input status of agitator motor A-320 starter auxillary (YY-320) at Motor Control Center (MCC) PCS.
(11) Input HAND and AUTO selection for pump motor P-310 (HS-310B).
(12) Input ON selection for pump motor P-310 (HS-310C).
(13) Input OFF selection for pump motor P-310 (HS-310D).
(14) Input FIELD DISCONNECT status for pump motor P-310 (HS-310A).
(15) Input status of pump motor P-310 starter auxillary (YY-310) at Motor Control Center (MCC) PCS.
(16) Input HAND and AUTO selection for pump motor P-311 (HS-311B).
(17) Input ON selection for pump motor P-311 (HS-311C).
(18) Input OFF selection for pump motor P-311 (HS-311D).
(19) Input FIELD DISCONNECT status for pump motor P-311 (HS-311A).
(20) Input status of pump motor P-311 starter auxillary (YY-311) at Motor Control Center (MCC) PCS.
(21) Input HAND and AUTO selection for pump motor P-330 (HS-330B).
(22) Input ON selection for pump motor P-330 (HS-330C).
(23) Input OFF selection for pump motor P-330 (HS-330D).
(24) Input FIELD DISCONNECT status for pump motor P-330 (HS-330A).
(25) Input status of pump motor P-330 starter auxillary (YY-330) at Motor Control Center (MCC) PCS.
(26) Input status of T-300 level transmitter (LT-300).
(27) Input status of T-320 level transmitter (LT-320).
(28) Input status of pump P-310 or P-311 discharge pressure transmitter (PT-310).
(29) Input status of pump P-330 discharge pressure transmitter (PT-330).
(30) Input status of T-300 flow indicating transmitter (FIT-300).
(31) Input status of T-320 flow indicating transmitter

(FIT-320).

(32) Input status of T-300 level control valve (LCV-300).

(33) Input status of T-320 level control valve (LCV-320).

3. Programmable Controller Subsystem Functions:

a. Control:

(1) If AUTO selected, provide ON-OFF function to agitator motor A-300.

(2) Totalize runtime in minutes for agitator A-300.

(3) Provide means to reset each runtime totalizer if reset function selected.

(4) Provide failure indication output if agitator A-300 stops running when it is supposed to be in run state.

(5) If AUTO selected, provide ON-OFF function to agitator motor A-320.

(6) Totalize runtime in minutes for agitator A-320.

(7) Provide means to reset each runtime totalizer if reset function selected.

(8) Provide failure indication output if agitator A-320 stops running when it is supposed to be in run state.

(9) If AUTO selected, provide ON-OFF function to pump motor P-310.

(10) Totalize runtime in minutes for pump P-310.

(11) Provide means to reset each runtime totalizer if reset function selected.

(12) Provide failure indication output if pump P-310 stops running when it is supposed to be in run state.

(13) If AUTO selected, provide ON-OFF function to pump motor P-311.

(14) Totalize runtime in minutes for pump P-311.

(15) Provide means to reset each runtime totalizer if reset function selected.

(16) Provide failure indication output if pump P-311 stops running when it is supposed to be in run state.

(17) Alternate operation of pumps P-310 and P-311 at a selected time interval or a default run time interval of seven days.

(18) If AUTO selected, provide ON-OFF function to pump motor P-330.

(19) Totalize runtime in minutes for pump P-330.

(20) Provide means to reset each runtime totalizer if reset function selected.

(21) Provide failure indication output if pump P-330 stops running when it is supposed to be in run state.

(22) Provide feedback control of Equilization Tank T-300 level by transmitting a digital signal to LCV-300. Feedback control loop shall have two modes: MANUAL and AUTO. In AUTO, level shall be maintained modulating LCV-300 until the level measured at LT-300 equals the setpoint. In MANUAL, LCV-300 may be manually modulated by varying the output digital signal until the desired level is acheived.

(23) Provide feedback control of Equilization Tank T-320 level by transmitting a digital signal to LCV-320. Feedback control loop shall have two modes: MANUAL and AUTO. In AUTO, level shall be maintained modulating LCV-320 until

the level measured at LT-320 equals the setpoint. In MANUAL, LCV-320 may be manually modulated by varying the output digital signal until the desired level is acheived.

(24) Provide output indication if LT-300 status changes.
(25) Provide output indication if LT-320 status changes.
(26) Provide output indication if PT-310 status changes.
(27) Provide output indication if PT-330 status changes.
(28) Provide output indication if FIT-300 status changes.
(29) Provide output indication if FIT-320 status changes.
(30) Provide output indication if LCV-300 status changes.
(31) Provide output indication if LCV-320 status changes.

b. Data Aquisition:

Monitor the following parameters:

(1) HAND and AUTO selection indication for agitators A-300, A-320, pumps P-310, P-311, P-330 (HS-XXXB).
(2) ON selection for agitators A-300, A-320, pumps P-310, P-311, and P-330 (HS-XXXC).
(3) OFF selection for agitators A-300, A-320, pupms P-310, P-311, and P-330 (HS-XXXD).
(4) FIELD DISCONNECT status for agitators A-300, A-320, pupms P-310, P-311, and P-330 (HS-XXXA).
(5) Motor starter status for agitators A-300, A-320, pupms P-310, P-311, and P-330 (YY-XXX) at MCC PCS.
(6) Status of LT-300.
(7) Status of LT-320.
(8) Status of PIT-310.
(9) Status of PIT-330.
(10) Status of FIT-300.
(11) Status of FIT-320.
(12) Status of LCV-300.
(13) Status of LCV-320.

Scale to engineering units and store in memory:

(14) Equilization tank T-300 Level, LT-300.
(15) Equilization tank T-320 Level, LT-320.
(16) Pump P-310 or P-311 Discharge Pressure , PIT-310.
(17) Pump P-330 Discharge Pressure , PIT-330.
(18) Equilization tank T-300 FLow Rate, FIT-300.
(19) Equilization tank T-320 Flow Rate, FIT-320.
(20) Level Control Valve LCV-300 Position, ZT-300.
(21) Level Control Valve LCV-320 Position, ZT-320.

c. Interlocks:

(1) Stop Equilization Tank T-300 discharge pump (P-310 or P-311) if: Actuator Position (ZSL-300) low.
(2) Stop Equilization Tank T-320 discharge pump (P-330) if: Actuator Position (ZSL-320) low.
(3) Stop Equilization Tank T-300 discharge pump (P-310 or P-311) if: Tank Level (LT-300) low.
(4) Stop Equilization Tank T-320 discharge pump (P-330) if: Tank Level (LT-320) low.
(5) Stop Equilization Tank T-300 discharge pump (P-310 or P-311) and Equilization Tank T-320 discharge pump (P-330) if: Lift Station #1 (T-610) Level (LT-610) high

high.

(6) Stop Equilization Tank T-300 discharge pump (P-310 or P-311) and Equilization Tank T-320 discharge pump (P-330) if: combined flow rates (FIT-300 and FIT-320) greater than 90 gpm.

d. Alarms:

(1) Equilization Tank T-300 Level (LT-300) high.
(2) Equilization Tank T-300 Level (LT-300) high high.
(3) Equilization Tank T-300 Level (LT-300) low.
(4) Equilization Tank T-300 Level (LT-300) low low.
(5) Equilization Tank T-320 Level (LT-320) high.
(6) Equilization Tank T-320 Level (LT-320) high high.
(7) Equilization Tank T-320 Level (LT-320) low.
(8) Equilization Tank T-320 Level (LT-320) low low.
(9) Equilization Tank T-300 Pump P-310 or P-311 Discharge Pressure (PIT-310) high.
(10) Equilization Tank T-300 Pump P-310 or P-311 Discharge Pressure (PIT-310) high high.
(11) Equilization Tank T-300 Pump P-310 or P-311 Discharge Pressure (PIT-310) low.
(12) Equilization Tank T-300 Pump P-310 or P-311 Discharge Pressure (PIT-310) low low.
(13) Equilization Tank T-300 Flow (FIT-300) high.
(14) Equilization Tank T-300 Flow (FIT-300) high high.
(15) Equilization Tank T-300 Flow (FIT-300) low.
(16) Equilization Tank T-300 Flow (FIT-300) low low.
(17) Equilization Tank T-320 Flow (FIT-320) high.
(18) Equilization Tank T-320 Flow (FIT-320) high high.
(19) Equilization Tank T-320 Flow (FIT-320) low.
(20) Equilization Tank T-320 Flow (FIT-320) low low.
(21) Equilization Tank T-300 Level Control Valve Position (ZT-300) failure.
(22) Equilization Tank T-320 Level Control Valve Position (ZT-320) failure.
(23) Equilization Tank T-300 Level Transmitter (LT-300) status change .
(24) Equilization Tank T-320 Level Transmitter (LT-320) status change.
(25) Equilization Tank T-320 Discharge Pump P-310 or P-311 Pressure Transmitter (PIT-310) status change .
(26) Equilization Tank T-320 Discharge Pump P-330 Pressure Transmitter (PIT-330) status change.
(27) Equilization Tank T-300 Flow Indicating Transmitter (FIT-300) status change.
(28) Equilization Tank T-320 Level Control Valve (LCV-300) status change.
(29) Equilization Tank T-320 Level Control Valve (LCV-320) status change.
(30) Agitator A-300 motor starter (YY-300) tripped.
(31) Agitator A-320 motor starter (YY-320) tripped.
(30) Pump P-310 motor starter (YY-310) tripped.
(30) Pump P-311 motor starter (YY-311) tripped.
(30) Pump P-330 motor starter (YY-330) tripped.

4. Supervisory Control and Data Aquisition System Functions:

The Man-Machine Interface (MMI) function of the SCADA system shall display the following information:

(1) Process control loop parameters and mode.

(2) Mode and status of agitators A-300, A-320, pumps P-300, P-311, and P-330

(3) Digital values of parameters listed in paragraph 3b items 14 to 21.

(4) Display cummulative run times of Equilization Tank agitators A-300, A-320, pumps P-310, P-311, and P-311

(5) Display alarm indications as listed in paragraph 3d. Provide means for alarm acknowledgement.

(6) Provide operator interface to:
Activate ON-OFF function to agitators A-300, A-320, pumps P-310, P-311, and P-330;
Change Equilization Tanks T-300 and T-320 level control loop parameters and mode;
Reset run time totalizer of each agitator and pump;
Change alarm setpoint value for digital parameters listed in paragraph 3b items 14 to 21;

(7) Provide real time trends of digital parameters listed in paragraph 3b items 14 to 21.

(8) Provide real time trend of level control loop output for Equilization Tanks T-300 and T-320.

All Unit Process parameters listed in paragraph 3b and alarms listed in paragraph 3d shall be made available over the communication link to the host computer and the Wonderware graphical process interface software.

F. Unit Process 3 - Air Oxidation and pH Adjustment
(P&ID I3)

1. Overview

a. The Air Oxidation and pH Adjustment Unit Process receives the combined effluents from Equilization Tanks T-300 and T-320 through a X" carbon steel line at a combined total flow rate not to exceed 90 gpm. The equilized ground water enters the Air Oxidation Tank where the pH is adjusted to a value not less than 10 pH units by the addition of 20% sodium hydroxide. An air stream is introduced to the tank from a stand alone blower to convert the metal hydroxides to their insoluble oxides for separation and removal from the process stream in Unit Process 3 (Clarification). In the event of blower failure, the system is equipped with a standby chemical oxidation system (HO). This system will be used for the oxidation of manganese in the treatment stream if present at concentrations greater than XX parts per million (ppm) or as the primary oxidation mechanism in the event of blower failure for an extend period of time. The effluent from the Air Oxidation Tank flows by gravity to the pH adjustment tank where the pH is monitored and maintained at 10 before discharge to Unit Process 3.

b. The Air Oxidation and pH Adjustment Unit Process consists of an air oxidation tank (T-400) and a pH adjustment tank (T-410), two top entry agitators (A-400 and A-410) a blower

(B-405), three positive displacement chemical feed pumps (P-402, P-403, and P-404), three flow indicators (FI-402, FI-403, and FI-404), three pressure indicators (PI-402, PI-403, and PI-404), two pH probes (AE-400 and AE-410), two pH transmitters (AIT-400 and AIT-410), three level switches (LS-402, LS-403A, and LS-403B), one flow switch (FS-405), three hand/off/auto switches (HS-402, HS-403, and HS-404), and twelve hand switches (HS-400A, HS-400B, HS-400C, HS-400D, HS-405A, HS-405B, HS-405C, HS-405D, HS-410A, HS-410B, HS-410C, and HS-410D).

2. Analog Subsystems Functions:
   a. Sensors/Transmitters:
      Measure the following parameters and transmit a analog signal to the local PCS:
      (1) pH of Tank T-400 (AIT-400).
      (2) pH of Tank T-410 (AIT-410).

   b. Control:
      (1) Input HAND and AUTO selection for agitator motor A-400 (HS-400B).
      (2) Input ON selection for agitator motor A-400 (HS-400C).
      (3) Input OFF selection for agitator motor A-400 (HS-400D).
      (4) Input FIELD DISCONNECT status for agitator motor A-400 (HS-400A).
      (5) Input status of agitator motor A-400 starter auxillary (YY-400) at Motor Control Center (MCC) PCS.
      (6) Input HAND and AUTO selection for agitator motor A-410 (HS-410B).
      (7) Input ON selection for agitator motor A-410 (HS-410C).
      (8) Input OFF selection for agitator motor A-410 (HS-410D).
      (9) Input FIELD DISCONNECT status for agitator motor A-410 (HS-410A).
      (10) Input status of agitator motor A-410 starter auxillary (YY-410) at Motor Control Center (MCC) PCS.
      (11) Input HAND and AUTO selection for blower motor B-405 (HS-405B).
      (12) Input ON selection for blower motor B-405 (HS-405C).
      (13) Input OFF selection for blower motor B-405 (HS-405D).
      (14) Input FIELD DISCONNECT status for blower motor B-405 (HS-405A).
      (15) Input status of blower motor B-405 starter auxillary (YY-405) at Motor Control Center (MCC) PCS.
      (16) Input HAND and AUTO selection for pump motor P-402 (HS-402).
      (17) Input status of pump motor P-402 power relay auxillary (YY-402).
      (18) Input HAND and AUTO selection for pump motor P-403 (HS-403).
      (19) Input status of pump motor P-403 power relay auxillary (YY-403).
      (20) Input HAND and AUTO selection for pump motor P-404 (HS-404).
      (21) Input status of pump motor P-404 power relay auxillary (YY-404).

(22) Input status of 20% Sodium Hydroxide Tote "A" level switch (LS-403A).
(23) Input status of 20% Sodium Hydroxide Tote "B" level switch (LS-403B).
(24) Input status of Hydrogen Peroxide Tote level switch (LS-402).
(25) Input status of blower flow switch (FS-405).

3. Programmable Controller Subsystem Functions:
   a. Control:
      (1) If AUTO selected, provide ON-OFF function to agitator motor A-400.
      (2) Totalize runtime in minutes for agitator A-400.
      (3) Provide means to reset each runtime totalizer if reset function selected.
      (4) Provide failure indication output if agitator A-400 stops running when it is supposed to be in run state.
      (5) If AUTO selected, provide ON-OFF function to agitator motor A-410.
      (6) Totalize runtime in minutes for agitator A-410.
      (7) Provide means to reset each runtime totalizer if reset function selected.
      (8) Provide failure indication output if agitator A-410 stops running when it is supposed to be in run state.
      (9) If AUTO selected, provide ON-OFF function to blower motor B-405.
      (10) Totalize runtime in minutes for blower B-405.
      (11) Provide means to reset each runtime totalizer if reset function selected.
      (12) Provide failure indication output if blower B-405 stops running when it is supposed to be in run state.
      (13) If AUTO selected, provide ON-OFF function to 20% sodium hydroxide feed pump motor P-403.
      (14) Totalize runtime in minutes for pump P-311.
      (15) Provide means to reset each runtime totalizer if reset function selected.
      (16) Provide failure indication output if pump P-311 stops running when it is supposed to be in run state.
      (17) If AUTO selected, provide ON-OFF function to 20% sodium hydroxide feed pump motor P-404.
      (18) Totalize runtime in minutes for pump P-404.
      (19) Provide means to reset each runtime totalizer if reset function selected.
      (20) Provide failure indication output if pump P-404 stops running when it is supposed to be in run state.
      (21) If AUTO selected, provide ON-OFF function to hydrogen peroxide feed pump motor P-402.
      (22) Totalize runtime in minutes for pump P-402.
      (23) Provide means to reset each runtime totalizer if reset function selected.
      (24) Provide failure indication output if pump P-402 stops running when it is supposed to be in run state.
      (25) Provide feedback control of Air Oxidation Tank T-400 pH by transmitting an analog signal to the local PCS. Feedback control loop shall have two modes: MANUAL and AUTO. In AUTO, addition of 20% sodium hydroxide shall be delivered by activating pump P-403 until the pH measured

at AIT-400 equals the setpoint. In MANUAL, pump P-403 may be activated to deliver 20% sodium hydroxide until the desired pH is acheived.

(26) Provide feedback control of pH Adjustment Tank T-410 pH by transmitting an analog signal to the local PCS. Feedback control loop shall have two modes: MANUAL and AUTO. In AUTO, addition of 20% sodium hydroxide shall be delivered by activating pump P-404 until the pH measured at AIT-410 equals the setpoint. In MANUAL, pump P-404 may be activated to deliver 20% sodium hydroxide until the desired pH is acheived.

(27) Provide timed control loop for the addition of Hydrogen Peroxide to Air Oxidation Tank T-400 in the event that manganese is present in the ground water flow stream or if desired as a backup in the event of blower B-405 failure. Feedback control loop shall have two modes: MANUAL and AUTO. In AUTO, addition of hydrogen peroxide shall be delivered by activating pump P-402 for a pre-determined time preiod at a preset time interval. In MANUAL, pump P-402 may be activated to deliver hydrogen peroxide until the quantity is added.

b. Data Aquisition:

Monitor the following parameters:

(1) HAND and AUTO selection indication for agitators A-400, A-410, blower B-405, pumps P-402, P-403, and P-404 (HS-XXXB).
(2) ON selection for agitators A-400, A-410, and blower B-405 (HS-XXXC).
(3) OFF selection for agitators A-400, A-410, and blower B-405 (HS-XXXD).
(4) FIELD DISCONNECT status for agitators A-400, A-410, and blower B-405 (HS-XXXA).
(5) Motor starter status for agitators A-400, A-410, blower B-405 (YY-XXX) at MCC PCS.
(6) HAND and AUTO selection indication for pumps P-402, P-403, and P-404 (HS-XXX).
(7) Power relay status for pumps P-402, P-403, and P-404 (YY-XXX) at local PCS.

Scale to engineering units and store in memory:

(6) Air Oxidation Tank T-400 pH, AIT-400.
(7) pH Adjustment Tank T-410 pH, AIT-410.

c. Interlocks:

(1) Stop Equilization Tank T-300 discharge pump (P-310 or P-311) if: 20% Sodium Hydroxide Tote "A" and Tote "B" level switch (LS-403A and LS-403B) low.
(2) Stop Equilization Tank T-320 discharge pump (P-330) if: 20% Sodium Hydroxide Tote "A" and Tote "B" level switch (LS-403A and LS-403B) low.
(3) Activate Hydrogen Peroxide Feed Pump System if: Air Oxidation Blower B-405 flow switch (FS-405) low.
(4) Stop Equilization Tank T-300 discharge pump (P-310 or P-311) if: Air Oxidation Blower B-405 flow switch

(FS-405) low and Hydrogen Peroxide Tote level switch (LS-402) low.

(5) Stop Equilization Tank T-320 discharge pump (P-330) if: Air Oxidation Blower B-405 flow switch (FS-405) low and Hydrogen Peroxide Tote level switch (LS-402) low.

d. Alarms:

(1) Air Oxidation Tank T-400 pH (AIT-400) high high.
(2) Air Oxidation Tank T-400 pH (AIT-400) high.
(3) Air Oxidation Tank T-400 pH (AIT-400) low low.
(4) Air Oxidation Tank T-400 pH (AIT-400) low.
(5) pH Adjustment Tank T-410 pH (AIT-410) high high.
(6) pH Adjustment Tank T-410 pH (AIT-410) high.
(7) pH Adjustment Tank T-410 pH (AIT-410) low low.
(8) pH Adjustment Tank T-410 pH (AIT-410) low.
(9) Agitator A-400 motor starter (YY-400) tripped.
(10) Agitator A-410 motor starter (YY-410) tripped.
(11) 20% Sodium Hydroxide Tote "A" level switch (LS-403A) high.
(12) 20% Sodium Hydroxide Tote "B" level switch (LS-403B) high.
(13) Hydrogen Peroxide Tote level switch (LS-402) high.
(14) Blower B-405 flow switch (FS-405) low.
(15) Pump P-402 power relay (YY-402) tripped.
(16) Pump P-403 power relay (YY-403) tripped.
(17) Pump P-404 power relay (YY-404) tripped.

4. Supervisory Control and Data Aquisition System Functions:
The Man-Machine Interface (MMI) function of the SCADA system shall display the following information:

(1) Process control loop parameters and mode.
(2) Mode and status of agitators A-400, A-410, pumps P-402, P-403, P-404, and blower B-405.
(3) Analog values of parameters listed in paragraph 3b items 6 to 7.
(4) Display cummulative run times of agitators A-400, A-410, pumps P-402, P-403, P-404, and blower B-405.
(5) Display alarm indications as listed in paragraph 3d. Provide means for alarm acknowledgement.
(6) Provide operator interface to:
Activate ON-OFF function to agitators A-400, A-410, pumps P-402, P-403, P-404, and blower B-405;
Change Air Oxidation Tank T-400 and pH Adjustment Tank T-410 pH control loop parameters and mode;
Reset run time totalizer of each agitator and pump;
Change alarm setpoint value for analog parameters listed in paragraph 3b items 6 to 7;
(7) Provide real time trends of analog parameters listed in paragraph 3b items 6 to 7.
(8) Provide real time trend of pH control loop output for Air Oxidation Tank T-400 and pH Adjustment Tank T-410.

All Unit Process parameters listed in paragraph 3b and alarms listed in paragraph 3d shall be made available over the communication link to the host computer and the Wonderware graphical process interface software.

G. Unit Process 4 - Clarification and Sand Filitration (P&ID I5 and I6)

1. Overview
   a. The three stage Lamella Clarifier receives waste water from the pH adjustment tank (T-410) through a 6" carbon steel pipe. A flocculating polymer is added to the agitated flash mixing zone which overflows to the agitated flocculation zone prior to entering the gravity settling zone. The settled solids are periodically removed to the sludge holding tank by an air driven diaphragm sludge transfer pump or recycled to the clarifier by an air driven diaphragm sludge recycle pump.

   b. The Dynasand Sand Filtration Unit receives clarified waste water from the Lamella Clarifier (T-500) through an 8" carbon steel pipe. The Sand Filter bed is under continual air sparging to facilitate removal of material that has passed through the clarifier. The waste stream is directed to Lift Station #3 (V-920; Ejector Station) via a 2" carbon steel line. Process waste is delivered to Lift Station #1 by an 8" carbon steel line.

   c. The Clarifier Unit Process consist of the three stage Lamella Gravity Clarifir (T-500), flash mixing zone agitator (A-501), flocculation zone agitator (A-502), gravity settling zone agitator (A-503), two air driven diaphragm pumps for sludge transfer and recycle (P-504 and P-505, respectively), two air control solenoids (FY-504 and FY-505), one polymer addition pump (P-506), two level switches (LS-500 and LS-506), two pressure indicating transmitters (PIT-504 and PIT-505), one pressure indicator (PI-506), one flow indicator (FI-506), two pressure reducing valves (PRV-504 and PRV-505), three hand/off/auto switches (HS-504, HS-505, and HS-506), and twelve hand switches (HS-501A, HS-501B, HS-501C, HS-501D, HS-502A, HS-502B, HS-502C, HS-502D, HS-503A, HS-503B, HS-503C, and HS-503D).

      The Sand Filtration Unit Process consist of the Dynasand Sand Filtration Unit (F-600), one pressure control valve (PCV-600), and one flow switch (FS-600).

   d. Recycling of the Clarifier sludge shall be accomplished by activation of the sludge recycle pump P-505 for a pre-deteremined time at a preset cycle time.

   e. Wasting of the Clarifier sludge to the Sludge Holding Tank shall be accomplished by activation of the sludge transfer pump P-504 for a pre-deteremined time at a preset cycle time.

2. Analog Subsystems Functions:
   a. Sensors/Transmitters:

Measure the following parameters and transmit a digital signal to the local PCS:

(1) Sludge Tranfer Pump P-504 discharge pressure (PIT-504).
(2) Sludge Recycle Pump P-505 discharge pressure (PIT-505).

b. Control:

(1) Input HAND and AUTO selection for agitator motor A-501 (HS-501B).
(2) Input ON selection for agitator motor A-501 (HS-501C).
(3) Input OFF selection for agitator motor A-501 (HS-501D).
(4) Input FIELD DISCONNECT status for agitator motor A-501 (HS-501A).
(5) Input status of agitator motor A-501 starter auxillary (YY-501) at Motor Control Center (MCC) PCS.
(6) Input HAND and AUTO selection for agitator motor A-502 (HS-502B).
(7) Input ON selection for agitator motor A-502 (HS-502C).
(8) Input OFF selection for agitator motor A-502 (HS-502D).
(9) Input FIELD DISCONNECT status for agitator motor A-502 (HS-502A).
(10) Input status of agitator motor A-502 starter auxillary (YY-502) at Motor Control Center (MCC) PCS.
(11) Input HAND and AUTO selection for agitator motor A-503 (HS-503B).
(12) Input ON selection for agitator motor A-503 (HS-503C).
(13) Input OFF selection for agitator motor A-503 (HS-503D).
(14) Input FIELD DISCONNECT status for agitator motor A-503 (HS-503A).
(15) Input status of agitator motor A-503 starter auxillary (YY-503) at Motor Control Center (MCC) PCS.
(16) Input HAND and AUTO selection for pump motor P-506 (HS-506).
(17) Input status of pump motor P-506 power relay auxillary (YY-506).
(18) Input HAND and AUTO selection for air driven diaphragm pump P-504 solenoid valve FY-504 (HS-504).
(19) Input HAND and AUTO selection for air driven diaphragm pump P-505 solenoid valve FY-505 (HS-505).
(20) Input status of Sludge Transmfer Pump Discharge Pressure Indicating Transmitter (PIT-504).
(21) Input status of Sludge recycle Pump Discharge Pressure Indicating Transmitter (PIT-505).

3. Programmable Controller Subsystem Functions:

a. Control:

(1) If AUTO selected, provide ON-OFF function to clarifier flash mixing zone agitator motor A-501.
(2) Totalize runtime in minutes for clarifier flash mixing zone agitator motor A-501.
(3) Provide means to reset runtime totalizer if reset function selected.
(4) Provide failure indication output if clarifier flash mixing zone agitator motor A-501 stops running when it is supposed to be in run state.
(5) If AUTO selected, provide ON-OFF function to clarifier flocculation mixing zone agitator motor A-502.

(6) Totalize runtime in minutes for clarifier flocculation mixing zone agitator motor A-502.
(7) Provide means to reset runtime totalizer if reset function selected.
(8) Provide failure indication output if clarifier flocculation mixing zone agitator motor A-502 stops running when it is supposed to be in run state.
(9) If AUTO selected, provide ON-OFF function to clarifier Lamella gravity settling zone agitator motor A-503.
(10) Totalize runtime in minutes for clarifier Lamella gravity settling zone agitator motor A-503.
(11) Provide means to reset runtime totalizer if reset function selected.
(12) Provide failure indication output if clarifier Lamella gravity settling zone agitator motor A-503 stops running when it is supposed to be in run state.
(13) Input status of Polymer Drum level switch (LS-506).
(14) Input status of Lamella Gravity Settling Zone level switch (LS-500).
(15) If AUTO selected, provide ON-OFF function for clarifier air driven Sludge Transfer Pump P-504.
(16) Totalize runtime in minutes for clarifier Sludge Transfer Pump P-504
(17) Provide means to reset runtime totalizer if reset function selected.
(18) Provide failure indication output if clarifier Sludge Transfer Pump P-504 stops running when it is supposed to be in run state by monitoring pump output pressure at PIT-504.
(19) Provide timed based control of Sludge Recycle Pump P-505 by activating air solenoid FY-505 once daily for a predetermined time period. Control loop shall have two modes: MANUAL and AUTO. In AUTO, air solenoid FY-505 shall be activated and maintained until countdown timer has expired. In MANUAL, air solenoid FY-505 may be activated and maintained until de-activation command has been issued or thirty minute "fail-safe" timer has expired.
(20) If AUTO selected, provide ON-OFF function for clarifier air driven Sludge Recycle Pump P-505.
(21) Totalize runtime in minutes for clarifier Sludge Recycle Pump P-505.
(22) Provide means to reset runtime totalizer if reset function selected.
(23) Provide failure indication output if clarifier Sludge Recycle Pump P-505 stops running when it is supposed to be in run state by monitoring pump output pressure at PIT-505.
(24) Provide timed based control of Sludge Recycle Pump P-505 by activating air solenoid FY-505 once daily for a predetermined time period. Control loop shall have two modes: MANUAL and AUTO. In AUTO, air solenoid FY-505 shall be activated and maintained until countdown timer has expired. In MANUAL, air solenoid FY-505 may be activated and maintained until de-activation command has been issued or thirty minute "fail-safe" timer has

expired.

(25) Input status of Compressed Air flow switch (FS-600).

(26) Provide output indication if PIT-504 status changes.

(27) Provide output indication if PIT-505 status changes.

b. Data Aquisition:

Monitor the following parameters:

(1) HAND and AUTO selection indication for agitators A-501, A-502, A-503 (HS-XXXB)

(2) ON selection for agitators A-501, A-502 and A-503 (HS-XXXC).

(3) OFF selection for agitators A-501, A-502, and A-503 (HS-XXXD).

(4) FIELD DISCONNECT status for agitators A-501, A-502, and A-503 (HS-XXXA).

(5) Motor starter status for agitators A-501, A-502, and A-503 (YY-XXX) at MCC PCS.

(6) HAND and AUTO selection indication for pumps P-504, P-505, and P-506 (HS-XXX).

(6) Power relay status for pumps P-506 (YY-XXX) at local PCS.

(7) Status of PIT-504.

(8) Status of PIT-505.

Scale to engineering units and store in memory:

(7) Sludge Transfer Pump discharge pressure PIT-504

(8) Sludge Recycle Pump discharge pressure PIT-505

c. Interlocks:

(1) Stop Equilization Tank T-300 discharge pump (P-310 or P-311) if: Polymer Drum level switch (LS-506) low.

(2) Stop Equilization Tank T-320 discharge pump (P-330) if: Polymer Drum level switch (LS-506) low.

(3) Stop Equilization Tank T-300 discharge pump (P-310 or P-311) if: Lamella Gravity Settling Zone level switch (LS-500) high.

(4) Stop Equilization Tank T-320 discharge pump (P-330) if: Lamella Gravity Settling Zone level switch (LS-500) high.

d. Alarms:

(1) Sludge Transfer Pump P-504 Discharge Pressure (PIT-504) high high.

(2) Sludge Transfer Pump P-504 Discharge Pressure (PIT-504) high.

(3) Sludge Transfer Pump P-504 Discharge Pressure (PIT-504) low low.

(4) Sludge Transfer Pump P-504 Discharge Pressure (PIT-504) low.

(5) Sludge Recycle Pump P-505 Discharge Pressure (PIT-505) high high.

(6) Sludge Recycle Pump P-505 Discharge Pressure (PIT-505) high.

(7) Sludge Recycle Pump P-505 Discharge Pressure (PIT-505) low low.

(8) Sludge Recycle Pump P-505 Discharge Pressure (PIT-505) low.
(9) Agitator A-501 motor starter (YY-501) tripped.
(10) Agitator A-502 motor starter (YY-502) tripped.
(11) Agitator A-503 motor starter (YY-503) tripped.
(12) Pump P-506 power relay (YY-506) tripped.
(13) Compressed air flow switch (FS-600) low.
(14) Sludge Transfer Pump P-504 Dischrge Pressure Transmitter (PIT-504) status change.
(15) Sludge Recycle Pump P-505 Dischrge Pressure Transmitter (PIT-505) status change.

4. Supervisory Control and Data Aquisition System Functions:
The Man-Machine Interface (MMI) function of the SCADA system shall display the following information:
(1) Process control parameters and mode.
(2) Mode and status Lamella Clarifier agitators A-501, A-502, A-503, pumps P-504, P-505, and P-506.
(3) Digital values of parameters listed in paragraph 3b items 7 and 8.
(4) Display cummulative run times of Lamella Clarifier agitator A-501, A-502, A-503, pumps P-504, P-505, and P-506.
(5) Display alarm indications as listed in paragraph 3d. Provide means for alarm acknowledgement.
(6) Provide operator interface to:
Activate ON-OFF function to Lamella Clarifier agitators A-501, A-502, and A-503;
Activate ON-OFF function to Sludge Transfer Clarifier Pumps P-504;
Activate ON-OFF function to Sludge Recycle Pump P-505;
Activate ON-OFF function to Polymer Feed Pump P-506;
Change sludge recycle control parameters and mode;
Change sludge transfer control parameters and mode;
Reset run time totalizer of Lamella Clarifier agitators;
Reset run time totalizer of Sludge Transfer and Recycle Pumps;
Reset run time totalizer of each Sludge Pump;
(10) Provide real time trends of digital parameters listed in paragraph 3b items 7 and 8.
(11) Provide real time status of sludge recycle control output.
(12) Provide real time trend of sludge transfer control output.

All Unit Process parameters listed in paragraph 3b and alarms listed in paragraph 3d shall be made available over the communication link to the host computer and the Wonderware graphical process interface software.

H. Unit Process 5 - Air Stripping
(P&ID I6 and I7)

1. Overview
a. The Air Stripping Unit Process influent stream is delivered from the Sand Filtration Unit by an 8" carbon steel pipe to Lift Station #1. Process water is pumped either to the Air Stripper or to Lift Station #2 for direct processing in the

Granulated Activated Carbon (GAC) Units. Sparging air is supplied by a stand-alone blower located inside Building 15. The Air Stripper operates at a maximum flow of 90 gpm measured at FIT-300 and FIT-310 and a constant influent organic concentration. Discharge from the Air Stripper sump is to Lift Station #2 where flow can be directed either to the GAC Unit for additional processing or to the pH Adjustment Tank for discharge to the local Publicly Owned Treatment Works (POTW).

b. The Air Stripping Unit Process consists of Lift Station #1 (T-610), Air Stripper Tower (ST-700), two self priming pumps (P-613 and P-614), one blower (B-710), one organic analyzer (AIT-611), one level transmitter (LT-610), one pressure indicating transmitter (PIT-613), one pressure differential indicating transmitter (PDIT-700), one level control valve (LCV-610), two flow valves (FV-700A and FV-700B), four pressure indicators (PI-613A, PI-613B, PI-614, PI-710), one level switch (LS-610), one flow switch (FS-710), and twelve hand switches (HS-613A, HS-613B, HS-613C, HS-613D, HS-614A, HS-614B, HS-614C, HS-614D, HS-710A, HS-710B, HS-710C, and HS-710D).

c. The Air Stripper Feed Sump (Lift Station #1) level shall be maintained by modulating the position of level control valve LCV-610 based on lift station level as measured by level transmitter LT-610. Flow to the Air Stripper will be maintained at less than 90 gpm as measured by flow transmitters FIT-300 and FIT-320 (Equilization Tank T-300 and Equilization Tank T-320 effluent flows).

d. The concentration of the organic constituents in the Air Stripper feed shall be maintained by measuring the organic concentration of the influent stream at AIT-611. Any change in the organic concentration from the setpoint will result in an adjustment to the ratio of Equilization Tank effluent flows.

2. Analog Subsystems Functions:
   a. Sensors/Transmitters:
      Measure the following parameters and transmit a digital signal to the local PCS:
      (1) Level of Lift Station #1 (LT-610).
      (2) Discharge Pressure of Lift Station Pumps P-613 or P-614 (PIT-613).
      (3) Position of Level Control Valve LCV-610 (ZT-610).
      (4) Pressure Differential of Air Stripper Tower ST-700 (PDIT-700).

      Measure the following parameters and transmit a linearly proportional analog signal to the local PCS:
      (5) Concentration of organics in Air Stripper influent stream (AIT-611).

   b. Control:
      (1) Input HAND and AUTO selection for pump motor P-613

(HS-613B).
(2) Input ON selection for pump motor P-613 (HS-613C).
(3) Input OFF selection for pump motor P-613 (HS-613D).
(4) Input FIELD DISCONNECT status for pump motor P-613 (HS-613A).
(5) Input status of pump motor P-613 starter auxillary (YY-613) at Motor Control Center (MCC) PCS.
(6) Input HAND and AUTO selection for pump motor P-614 (HS-614B).
(7) Input ON selection for pump motor P-614 (HS-614C).
(8) Input OFF selection for pump motor P-614 (HS-614D).
(9) Input FIELD DISCONNECT status for pump motor P-614 (HS-614A).
(10) Input status of pump motor P-614 starter auxillary (YY-614) at Motor Control Center (MCC) PCS.
(11) Input HAND and AUTO selection for blower motor B-710 (HS-710B).
(12) Input ON selection for blower motor B-710 (HS-710C).
(13) Input OFF selection for blower motor B-710 (HS-710D).
(14) Input FIELD DISCONNECT status for blower motor B-710 (HS-710A).
(15) Input status of blower motor B-710 starter auxillary (YY-710) at Motor Control Center (MCC) PCS.
(16) Input status of Blower B-710 Flow Switch (FS-710).
(17) Input status of Lift Station #2 (T-610) Discharge Level Transmitter (LT-610).
(18) Input status of Lift Station #2 (T-610) Discharge Pressure Indicating Transmitter (PIT-613).
(19) Input status of Lift Station #2 (T-610) Level Control Valve (LCV-610).
(20) Input status of Air Strippper T-700 Pressure Differential Indicating Transmitter (PDIT-700).
(21) Input status of Air Stripper Flow Valve (FV-700A).
(22) Input status of Air Stripper Diverter Flow Valve (FV-700B).

3. Programmable Controller Subsystem Functions:
   a. Control:
      (1) If AUTO selected, provide ON-OFF function to Lift Station #1 (T-610) pump motor P-613.
      (2) Totalize runtime in minutes for Lift Station #1 (T-610) pump motor P-613.
      (3) Provide means to reset runtime totalizer if reset function selected.
      (4) Provide failure indication output if Lift Station #1 (T-610) pump motor P-613 stops running when it is supposed to be in run state.
      (5) If AUTO selected, provide ON-OFF function to Lift Station #1 (T-610) pump motor P-614.
      (6) Totalize runtime in minutes for Lift Station #1 (T-610) pump motor P-614.
      (7) Provide means to reset runtime totalizer if reset function selected.
      (8) Provide failure indication output if Lift Station #1 (T-610) pump motor P-614 stops running when it is supposed to be in run state.

(9) Alternate operation of pumps P-613 and P-614 at a selected time interval or a default run time interval of seven days.
(10) Provide feedback control of Lift Station #1 Tank T-610 level by transmitting a digital signal to LCV-610. Feedback control loop shall have two modes: MANUAL and AUTO. In AUTO, level shall be maintained by modulating LCV-610 until the level measured at LT-610 equals the setpoint. In MANUAL, LCV-610 may be manually modulated by varying the output digital signal until the desired level is acheived.
(11) Provide feedback control of Equilization Tanks T-300 and T-320 discharge pump ratio by transmitting a digital signal to LCV-300 and LCV-320. Feedback control loop shall have two modes: MANUAL and AUTO. In AUTO, discharge pump ratio shall be maintained by modulating LCV-300 and LCV-320 until the organic concentration measured at AIT-611 equals the setpoint. In MANUAL, LCV-300 and LCV-320 may be manually modulated by varying the output digital signal until the desired ratio is acheived.
(12) Provide output indication if LT-610 status changes.
(13) Provide output indication if PIT-613 status changes.
(14) Provide output indication if LCV-610 status changes.
(15) Provide output indication if PDIT-700 status changes.
(16) Provide output indication if FV-700A status changes.
(17) Provide output indication if FV-700B status changes.

b. Data Aquisition:
Monitor the following parameters:
(1) HAND and AUTO selection indication for pump P-613, P-614 and blower B-710. (HS-XXXB)
(2) ON selection for pumps P-613, P-614, and blower B-710 (HS-XXXC).
(3) OFF selection for pumps P-613, P-614 and blower B-710 (HS-XXXD).
(4) FIELD DISCONNECT status for pumps P-613, P-614, and blower B-710 (HS-XXXA).
(5) Motor starter status for pumps P-613, P-614 and blower B-710 (YY-XXX) at MCC PCS.
(6) Status of LT-610.
(7) Status of PIT-613.
(8) Status of LCV-610.
(9) Status of PDIT-700.
(10) Status of FV-700A.
(11) Status of FV-700B.

Scale to engineering units and store in memory:
(5) Lift Station #1 (T-610) Level, LT-610.
(6) Lift Station #1 (T-610) Pump P-613 or P-614 Discharge Pressure, PIT-613.
(7) Position of Level Control Valve, ZT-610.
(8) Air Stripper ST-700 Pressure Differential, PDIT-700.

c. Interlocks:
   (1) Stop Lift Station #1 Pump P-613 or P-614 and Blower B-710 30 minutes later if: LT-610 low low.
   (2) Stop Lift Station #1 Pump P-613 or P-614 and Blower B-710 30 minutes later if: AIT-611 high high.
   (3) Stop Lift Station #1 Pump P-613 or P-614 and Blower B-710 30 minutes if: PDIT-700 high high.
   (4) Stop Equilization Pumps P-300 and P-320 if: LT-610 high high.
   (5) Stop Lift Station #1 Pump P-613 or P-614 and Blower B-710 if: FS-710 low.

d. Alarms:
   (1) Lift Station #1 Level (LT-610) high high.
   (2) Lift Station #1 Level (LT-610) high.
   (3) Lift Station #1 Level (LT-610) low low.
   (4) Lift Station #1 Level (LT-610) low.
   (5) Lift Station #1 Pump P-613 or P-614 Discharge Pressure (PIT-613) high high.
   (6) Lift Station #1 Pump P-613 or P-614 Discharge Pressure (PIT-613) high.
   (7) Lift Station #1 Pump P-613 or P-614 Discharge Pressure (PIT-613) low low.
   (8) Lift Station #1 Pump P-613 or P-614 Discharge Pressure (PIT-613) low.
   (9) Organic Concentration Analyzer (AIT-611) high high.
   (10) Organic Concentration Analyzer (AIT-611) high.
   (11) Organic Concentration Analyzer (AIT-611) low low.
   (12) Organic Concentration Analyzer (AIT-611) low.
   (13) Air Stripper ST-700 Pressure Differential Pressure (PDIT-700) high high.
   (14) Air Stripper ST-700 Pressure Differential Pressure (PDIT-700) high.
   (15) Air Stripper ST-700 Pressure Differential Pressure (PDIT-700) low low.
   (16) Air Stripper ST-700 Pressure Differential Pressure (PDIT-700) low.
   (17) Pump P-613 motor starter (YY-613) tripped.
   (18) Pump P-614 motor starter (YY-614) tripped.
   (19) Blower B-710 motor starter (YY-710) tripped.
   (20) Lift Station #1 (T-610) Level Transmitter (LT-610) status change.
   (21) Lift Station #1 (T-610) Pump P-613 or P-614 dicharge Pressure Transmitter (PIT-613) status change.
   (22) Lift Station #1 (T-610) Level Control Valve (LCV-610) status change.
   (23) Air Stripper ST-700 Pressure Differential Transmitter (PDIT-700) status change.
   (24) Air Stripper Flow Valve (FV-700A) status change.
   (25) Air Stripper Diverter Flow Valve (FV-700B) status change.

4. Supervisory Control and Data Aquisition System Functions:
   The Man-Machine Interface (MMI) function of the SCADA system shall display the following information:
   (1) Process control loop parameters and mode.
   (2) Mode and status of lift station #1 pumps P-613, P-614 and

blower B-710.

(3) Digital values of parameters listed in paragraph 3b items 5 to 8.

(4) Display cummulative run times of lift station #1 pumps P-613, P-614 and blower B-710.

(5) Display alarm indications as listed in paragraph 3d and provide means for alarm acknowledgement.

(6) Provide operator interface to:
Activate ON-OFF function to pumps P-613, P-614 and blower B-710;
Change Lift Station #1 Level control loop parameters and mode;
Reset run time totalizer of the pumps and blower;

(7) Provide real time trends of analog parameters listed in paragraph 3b items 5 to 8.

(8) Provide real time trend of level control loop output.

All Unit Process parameters listed in paragraph 3b and alarms listed in paragraph 3d shall be made available over the communication link to the host computer and the Wonderware graphical process interface software.

K. Unit Process 6 - Granulated Activated Carbon (GAC) System (P&IDs I7, I8, and I10)

1. Overview

a. The GAC system consists of two units, piped as a pair, with carbon capacity of 20,000 pounds each. The GAC units are 10 feet in diameter by 18 feet total height and are capable of operating at pressures of 125 psig. Treated groundwater is pumped from the Lift Station #2 (T-715) to the GAC system through a 4" carbon steel pipe. Flow to the GAC unit may be diverted directly to the pH Adjustment Tank by means of a flow control valve. The effluent from the GAC system flows through a 4" carbon steel pipe to the Final pH Adjustment Tank.

b. The GAC System Unit Process shall consist of two Model 10 Granulated Activated Carbon Units (F-801 and F-802) lift station #2 (T-715), two self priming pumps (P-717 and P-718), thirteen flow valves (FV-800A, FV-800B, FV-800C, FV-800D, FV-800E, FV-801A, FV-801B, FV-801C, FV-801D, FV-802A, FV-802B, FV-802C and FV-802D), three pressure transmitters (PT-801A, PT-801B and PT-802), two pressure differential switches (PDS-801 and PDS-802), one level transmitter (LT-715), one level control valve (LCV-715), three pressure indicators (PI-717A, PI-717B, and PI-718), one pressure indicating transmitter (PIT-717), one level switch (LS-715), and eight hand switches (HS-717A, HS-717B, HS-717C, HS-717D, HS-718A, HS-718B, HS-718C, and HS-718D).

c. Treated Groundwater flow through GAC unit F-XXX (where XXX identifies the individual GAC unit) shall be acheived by opening flow valves FV-XXXB and FV-XXXC

d. At scheduled intervals, or when PDS-XXX is activated, the GAC units shall be backwashed at a flow of 560 gpm. Backwash shall be automatically controlled after initiation by operating personnel. The backwash cycle shall close FV-XXXB and FV-XXXC and open FV-XXXXA and FV-XXXXD of the GAC unit to be backwashed.

2. Analog Subsystems Functions:
   a. Sensors/Transmitters:
      Measure the following parameters and transmit a digital signal to the local PCS:
      (1) Level of Lift Station #2 (LT-715).
      (2) Discharge Pressure of Lift Station #2 Pump P-717 or P-718 (PIT-717).
      (3) Position of Lift Station #2 (T-715) Level Control Valve (LCV-715).
      (4) Inlet Pressure of GAC F-801 or F-802 (PT-801A).
      (5) Outlet Pressure of GAC F-801 (PT-801B).
      (6) Outlet Pressure of GAC F-802 (PT-802).
      (7) Position of GAC System Flow Valve (FV-800B).
      (8) Position of GAC System By-pass Flow Valve (FV-800A).
      (9) Position of GAC System Backwash Waste Flow Valve (FV-800D).
      (10) Position of GAC System Waste Flow Valve (FV-800E).
      (11) Position of GAC System Bachwash Water Feed Flow Valve (FV-800C).
      (12) Position of GAC F-801 Inlet Valve (FV-801B).
      (13) Position of GAC F-801 Oultet Valve (FV-801C).
      (14) Position of GAC F-801 Bachwash Inlet Valve (FV-801D).
      (15) Position of GAC F-801 Bachwash Oultet Valve (FV-801A).
      (16) Position of GAC F-802 Inlet Valve (FV-802B).
      (17) Position of GAC F-802 Oultet Valve (FV-802C).
      (18) Position of GAC F-802 Bachwash Inlet Valve (FV-802D).
      (19) Position of GAC F-802 Bachwash Oultet Valve (FV-802A).

   b. Control:
      (1) Input HAND and AUTO selection for pump motor P-717 (HS-717B).
      (2) Input ON selection for pump motor P-717 (HS-717C).
      (3) Input OFF selection for pump motor P-717 (HS-717D).
      (4) Input FIELD DISCONNECT status for pump motor P-717 (HS-717A).
      (5) Input status of pump motor P-717 starter auxillary (YY-717) at Motor Control Center (MCC) PCS.
      (6) Input HAND and AUTO selection for pump motor P-718 (HS-718B).
      (7) Input ON selection for pump motor P-718 (HS-718C).
      (8) Input OFF selection for pump motor P-718 (HS-718D).
      (9) Input FIELD DISCONNECT status for pump motor P-718 (HS-718A).
      (10) Input status of pump motor P-718 starter auxillary (YY-718) at Motor Control Center (MCC) PCS.
      (11) Input status of Lift Station Level Transmitter (LT-715).
      (12) Input status of Lift Station Level Control Valve

(LCV-715).

(13) Input status of Lift Station Pump Discharge Pressure Transmitter (PIT-717).

(14) Input status of GAC F-801 or F-802 Inlet Pressure Transmitter (PT-801A).

(15) Input status of GAC F-801 Outlet Pressure Transmitter (PT-801B).

(16) Input status of GAC F-802 Outlet Pressure Transmitter (PT-802).

(17) Input status of Flow Valves FV-800A, FV-800B, FV-800C, FV-800D, and FV-800E.

(18) Input status of Flow Valves FV-801A, FV-801B, FV-8012C, and FV-801D.

(19) Input status of Flow Valves FV-802A, FV-802B, FV-8022C, and FV-802D.

3. Programmable Controller Subsystem Functions:

a. Control:

(1) Provide feedback control of Lift Station #2 level by transmitting a digital signal to LCV-715. Feedback control loop shall have two modes: MANUAL and AUTO. In AUTO, valve position shall be adjusted until the level measured at LT-715 equals the setpoint. In MANUAL, valve position shall be adjusted by manually varying the loop output digital signal.

(2) Totalize runtime in minutes for individual GAC Units

(3) Provide means to reset each runtime totalizer if reset function selected.

(4) If AUTO selected, provide ON-OFF function to Lift Station #2 (T-610) pump motor P-717.

(5) Totalize runtime in minutes for Lift Station #2 (T-610) pump motor P-717.

(6) Provide means to reset runtime totalizer if reset function selected.

(7) Provide failure indication output if Lift Station #2 (T-610) pump motor P-717 stops running when it is supposed to be in run state.

(8) If AUTO selected, provide ON-OFF function to Lift Station #2 (T-610) pump motor P-718.

(9) Totalize runtime in minutes for Lift Station #2 (T-610) pump motor P-718.

(10) Provide means to reset runtime totalizer if reset function selected.

(11) Provide failure indication output if Lift Station #2 (T-610) pump motor P-718 stops running when it is supposed to be in run state.

(12) Alternate operation of pumps P-717 and P-718 at a selected time interval or a default run time interval of seven days.

(13) Provide control of GAC System Flow Valves as follows:
If feed to GAC units is desired, open FV-800B and FV-800E, close FV-800A, FV-800D, and FV-800C.
If backwask is desired close FV-800B and FV-800E and open FV-800C and FV-800D.
If GAC Unit By-pass is desired close FV-800B and FV-800E and open FV-800A.

(14) Provide output indication if LT-715 status changes.
(15) Provide output indication if PIT-717 status changes.
(16) Provide output indication if LCV-715 status changes.
(17) Provide output indication if PT-801A status changes.
(18) Provide output indication if PT-801B status changes.
(19) Provide output indication if PT-802 status changes.
(20) Provide output indication if FV-800A, FV-800B, FV-800C, FV-800D, or FV-800E status changes.
(21) Provide output indication if FV-801A, FV-801B, FV-801C, or FV-801D status changes.
(22) Provide output indication if FV-802A, FV-802B, FV-802C, or FV-802D status changes.

b. Data Aquisition:
Monitor the following parameters:
(1) HAND and AUTO selection indication for pump P-717 and P-718. (HS-XXXB)
(2) ON selection for pumps P-717 and P-718 (HS-XXXC).
(3) OFF selection for pumps P-717 and P-718 (HS-XXXD).
(4) FIELD DISCONNECT status for pumps P-717 and P-718 (HS-XXXA).
(5) Motor starter status for pumps P-717 and P-718 (YY-XXX) at MCC PCS.
(6) Status of LT-715.
(7) Status of PIT-717.
(8) Status of LCV-715.
(9) Status of PT-801A.
(10) Status of PT-801B.
(11) Status of PT-802.
(12) Status of FV-800A, FV-800B, FV-800C, FV-800D and FV-800E.
(13) Status of FV-801A, FV-801B, FV-801C, and FV-801D
(14) Status of FV-802A, FV-802B, FV-802C, and FV-802D

Scale to engineering units and store in memory:
(15) Lift Station #2 (T-715) level (LT-715).
(16) Lift Station #2 (T-715) Pump P-717 or P-718 Discharge Pressure, PIT-717.
(17) Position of Level Control Valve, ZT-715.
(18) GAC System Inlet Pressure (PT-801A).
(19) GAC F-801 Outlet Pressure (PT-801B).
(20) GAC F-802 Outlet Pressure (PT-802).

c. Interlocks:
(1) When System is in operation FV-800A may be opened if: correct password has been entered.
(2) Stop Lift Station #2 Pump P-717 or P-718 if: GAC System inlet pressure PT-801A is high high.

d. Alarms:
(1) Lift Station #2 Level (LT-715) high high.
(2) Lift Station #2 Level (LT-715) high.
(3) Lift Station #2 Level (LT-715) low low.
(4) Lift Station #2 Level (LT-715) low.

(5) Lift Station #2 Pump P-715 or P-718 Discharge Pressure (PIT-613) high high.
(6) Lift Station #2 Pump P-715 or P-718 Discharge Pressure (PIT-613) high.
(7) Lift Station #2 Pump P-715 or P-718 Discharge Pressure (PIT-613) low low.
(8) Lift Station #2 Pump P-715 or P-718 Discharge Pressure (PIT-613) low.
(9) Pump P-717 motor starter (YY-717) tripped.
(10) Pump P-718 motor starter (YY-718) tripped.
(11) Lift Station #1 (T-715) Level Transmitter (LT-715) status change.
(12) Lift Station #1 (T-715) Pump P-717 or P-718 dicharge Pressure Transmitter (PIT-717) status change.
(13) Lift Station #1 (T-715) Level Control Valve (LCV-715) status change.
(14) GAC Inlet Pressure Transmitter (PT-801A) status change.
(15) GAC Unit F-801 outlet Pressure Transmitter (PT-801B) status change.
(16) GAC Unit F-802 outlet Pressure Transmitter (PT-802) status change.
(17) GAC System Flow Valves FV-800A, FV-800B, FV-800C, FV-800D or FV-800E status change.
(18) GAC Unit F-801 Flow Valves FV-801A, FV-801B, FV-801C, or FV-801D status change.
(19) GAC Unit F-802 FV-802A, FV-802B, FV-802C, or FV-802D status change.

4. Supervisory Control and Data Aquisition System Functions:
The Man-Machine Interface (MMI) function of the SCADA system shall display the following information:
(1) Process control loop parameters and mode.
(2) Analog values of parameters listed in paragraph 3b items 15 to 20.
(3) Display cummulative run times of individual GAC Units
(4) Display alarm indications as listed in paragraph 3d.
(5) Provide means for alarm acknowledgement.
(6) Provide operator interface to:
Select individual GAC Units;
Select individual GAC Units for backwash;
Activate ON-OFF function to Lift Station #2 Pump P-717 or P-718;
Change Lift Station #2 level control loop parameters and mode;
Reset run time totalizer of individual GAC Units;
(7) Provide real time trends of analog parameters listed in paragraph 3b items 15 to 20.

All Unit Process parameters listed in paragraph 3b and alarms listed in paragraph 3d shall be made available over the communication link to the host computer and the Wonderware graphical process interface software.